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QUA VADIMUS?[1]

The task of an investigator requires for its success the toughness of a soldier, the temper of a saint and the training of a scholar.—*Humphry Davy.*

The philosopher should be a man willing to listen to every suggestion, but determined to judge for himself. He should not be biassed by appearances; have no favorite hypothesis; be of no school; and in doctrine have no master. He should not be a respecter of persons, but of things. Truth should be his primary subject. If to these qualities be added industry, he may indeed hope to walk within the veil of the temple of nature.—*Michael Faraday.*

FROM the orb which daily throws its golden rays upon this university,[2] came on November 14, 1925, the announcement of an anonymous gift to Cornell, the income of which is to be used for the "benefit and advancement of teaching and research in chemistry. The gift was made to enable the University to carry out a plan formulated by Professor L. M. Dennis, Head of the Department of Chemistry. Distinguished men of this and other countries in chemistry and allied fields of science were to be invited to spend one or two semesters at Cornell delivering lectures, conducting research, and generally collaborating with the Department while in residence here."

Some days later there followed the announcement, "Dutch chemist accepts offer to teach here." Let me assure you that I feel very much honored by your kindness in choosing me as the first incumbent and that I fully realize the duties laid upon me by your doing so. I sincerely hope that this establishment of the new "non-resident lectureship" may, as the years go on, bring the results that were in the mind of the anonymous benefactor when he made this generous gift to Cornell.

When, for about a quarter of a century, a man has, day after day, devoted himself to university instruction, has seen numerous generations enter the Temple of Minerva, and has seen them leave her sanctum decked with the doctor's hood, when he has passed those years in unbroken and intimate intercourse with his pupils, it is obvious that he is perfectly well acquainted with the difficulties which many of them have met on their way.

[1] Introductory public lecture delivered by Professor Ernst Cohen, first incumbent of the non-resident lectureship in chemistry recently established at Cornell University.

[2] *The Cornell Daily Sun.*

Qua vadimus? Which way shall we go? How are we to arrange our studies? This is the question which year after year many new students ask themselves when they enter the gate of the university, and not only themselves, but also their older colleagues, or the professors to whose guidance they are going to entrust themselves, for in most cases it appears that they themselves are unable to answer this question satisfactorily.

How could it be otherwise? For do they not take a road totally different from the one they have trod up to this time? Are not the requirements totally different now that they are no longer under rigid scholastic restraint? Is it any wonder that they are in the position of the medical practitioner who standing at a sick bed is often confronted with the problems of solving an equation with thirty unknown quantities? The demands which society will make of the beginner in the execution of his scientific profession are such that only he can hope to satisfy them, who knows how to use in the most practical way the time allotted to him for study and for scientific development. Means to attend this end—lectures, practical class-work, books, colloquia, students' lectures, excursions—are not wanting in these days; on the contrary, there is rather "embarras de choix," but the difficulty for the future scientist is to choose rightly, at the proper moment, and after the choice, he must solve the question: "In what way can I make the most practical use of the means that are presented to me?"

Let us pass in review the whole machinery of instruction and indicate the importance and meaning of every part, while at the same time we answer the question how to make the best use of these parts. And let us bear in mind that the student's "Lehr und Wanderjahre" should make him not only a scholar, but especially a "man."

"Die Vorlesungen sind eine unangenehme Unterbrechung der Ferien!" ("The lectures are an unpleasant interruption of the holidays!") is a well-known complaint uttered by professor and student alike, but let us not forget that these are at least of *some* use. Purposely I say "of some use," for experience teaches that the student is apt to overrate the significance of lectures. Enter the lecture room when the students, eager for knowledge, are assembled there, and you will conclude from the continual scratching of pens, which indicates that the words of the professor are perpetuated on paper, that "taking down verbatim" is considered to be a highly important part of the curriculum. Times have changed: seventy-five years ago the renowned Dutch author, Kneppelhout, published his "College Life," a book well worth reading even now, in which with caustic irony he divides the professors into *two* classes: the dictating professors, and the teaching. He berates the former roundly, because they compel the young man of twenty to keep up with the erratic rate of the glib lips, without allowing him time to let his brains catch their line of thought: nowadays it is the student who seems to attach such an immense importance to taking down the words he manages to catch. The more experienced student wonders if short notes worked out as soon as possible after the lecture would not answer the purpose much better, with the simultaneous use of text-books to which he is so often referred.

Would not this lead to a great saving of time? By this method he would avoid the one-sidedness which is a common error of the student in taking the professor's exposition as the only correct and the only possible one. In this way the student easily escapes the rock of "jurare in verba magistri," which is so dangerous especially to the beginner. Moreover, the use of good books when working out what he has heard in the lecture room offers the great advantage that the student gets a better insight into the real value and the significance of a lecture in general.

The subjects are discussed from the professor's subjective point of view as regards the importance which ought to be attached to certain special parts of the science he teaches. Thus it may happen that more attention is paid to subjects to which the professor has especially devoted his energies than to others, no less important, which are farther removed from his special field of investigation. The text-book will draw the student's attention to the existence and importance of such subjects, perhaps acquaint him with problems which captivate him more strongly than those of which he heard in the lectures. And in this way he enters, as it were imperceptibly, the domain of independent study, the study which distinguishes the university from the schools he has just left.

I hear one of you object: "Yes, all this is very fine, but in the examination we are required to know all that has been treated in the lectures." Then my reply is: "Undoubtedly there are lectures, especially those given to freshmen in which the elements of a certain science are presented, and it is absolutely necessary for every one who wishes to go deeper into this science to be well acquainted with all that is treated in the lectures. But this is true of a few courses only. It is absolutely untrue for advanced students and for these a deeper insight into, and a broader view of the matter is of the greatest importance. No reasonable teacher will ever insist that his pupils pay most attention to those parts of science which he has treated exhaustively in a course of lectures. The purport of these lectures is to fix the student's attention on important points, to acquaint him with the literature which has been published on

that particular subject, to point out the way in which certain problems may be studied in connection with the present advance of learning, and, in the last instance, all this is intended not only to make him acquainted with those problems and the way of solving them, but especially to awaken his love for the study of other topics which have not been treated, and so to fit him for the solution of new problems. I am sure that you will agree with me when I say that this end can not be attained by mastering only that which is taken down in the lecture room. I can give you a striking example. When studying thermodynamics, many students, I may say most, are satisfied with studying the derivation of the numerous relations which the lecture teaches them. When they have to apply the formulas thus derived, we are immediately aware that they are not able to do so, especially in the computation of concrete cases. Only by continual practice in the solving of problems is it possible to get a clear understanding of the subject.

But again I hear the objection that this method of study would take up too much time; that those who wish to complete their university course within a reasonable period have not sufficient leisure for such practice. Allow me to set your mind at ease on this point. The man who takes up his studies in this way saves a lot of time. The thorough method is far superior to the superficial. It is true that at first the beginner will think that he makes little headway, but this impression is entirely wrong and soon disappears. The numerous, disheartening repetitions which are the lot of those who are less conscientious are eliminated in this way. The Italian proverb obtains here also: Che va piano, va longano, e va lontano (Who goes slowly, goes a long way and goes far).

Practical class-work, if judiciously ordered, forms a pleasant and powerful help to stimulate the studies at the writing-desk which, especially at first, are more or less monotonous. Many generations of students have experienced this since Justus von Liebig insisted on practical class-work as an inherent part of chemical study. He put this idea in practice at his celebrated laboratory at Giessen. As early as 1683, Johann Moritz Hoffmann, professor of medicine at Altorf, expressed the same idea. And to-day we may make Pasteur's words our own: "Les laboratoires sont les temples de l'avenir, de la richesse et du bien-être; c'est là que l'humanité grandit, se fortifie et devient meilleure." (The laboratories are the temples of the future, of wealth and well-being; there mankind grows, gains strength and progresses.)

I just now used the phrase, "if judiciously ordered." This is true for the teacher who must make the best choice out of the heap of material that lies ready to hand, as well as for the students as regards the manner in which they make use of the opportunities which are offered them.

In connection with the high educational value which a correct method of practical class-work possesses, I will enlarge on this point for a moment. "Ce n'est pas assez de savoir les principes; il faut savoir manipuler." (It is not sufficient to know the principles: manipulation must also be mastered.) No less a person than Michael Faraday took those words for his motto when he published his first manual of practical chemistry, "Chemical Manipulation," being instructions to students in chemistry on the methods of performing experiments of demonstration or of research with accuracy and success. For many decades the great importance and the deep significance of this "savoir manipuler" has been recognized all over the civilized world, and to-day this principle is everywhere introduced in our teaching of the non-mathematical sciences. Therefore, it may appear to be unnecessary to point out once more that for the prospective natural philosopher it is of the utmost importance to apply himself, heart and soul, to this branch of his studies. Yet experience has taught me that, especially at the beginning, most students do not realize this obvious truth. Furthermore, whoever thinks that a working day of eight hours will be sufficient for him to attain his purpose, let him desist from the study of the exact sciences and choose a sphere of activity in which the number of working hours is regulated by law.

Every chemist must be skilled in recognizing and detecting the substances which he handles every day, that is, in qualitative analysis, and it stands to reason that he must also be thoroughly familiar with the methods which acquaint him with the quantitative composition of those substances. Whatever career he will follow afterwards, he must have mastered the A, B, C of these methods. It seems commonplace to enlarge on these points, but my excuse is that more than once I have met students who were strangely deficient in their knowledge of analysis. I willingly admit that there is a certain monotony in making oneself familiar with these manipulations, that for many it is "making the best of a bad job," but it is an absolute necessity.

Then we should not forget that performing analytical operations offers an excellent opportunity of training oneself in keen observation, in accuracy, and, last but not least, in economizing time. He who is able to perform a number of analyses simultaneously and to divide his time in the most practical and economical way, acquires qualities which are of great use to him in future years in every branch of study. He learns to make the most of his time. We can not enter into further particulars about this

point, but I wish to call attention to a serious mistake which is very common and which often leads to a highly undesirable waste of time and material. Many students, after a quantitative measurement, put off the calculation of the results until after a second experiment. Now this is most unwise, for often the calculation shows that some error has been made, and if this error had been known to the student before the second experiment had been carried out, he would have been warned in time to avoid the rock on which his first experiment had stranded. For the serious worker, "manipuler" has another great advantage—it compels him to bear continually in mind the principles on which his work is based, and to recall and put into practice that which he has heard in the lecture room or read in his books. This advantage, however, is only for him who does not work mechanically, or does not blindly follow the manuals he uses in the laboratory, without verifying the laws they teach.

The memorable words of Clemens Winkler should be engraved over the entrance of every chemical laboratory, and not only there, but also on the mind of every student of chemistry:

> Die wirklich erfolgreiche Durchführung anorganisch-chemischer (I add: organischer und physikalisch-chemischer) Arbeiten ist aber nur demjenigen möglich, der nicht allein theoretischer Chemiker, sondern auch vollendeter Analytiker ist, und zwar nicht nur ein praktisch angelernter mechanischer Arbeiter, sondern ein denkender, gestaltender Künstler, vor dem jede der durchgeführten Operationen in theoretischer Klarheit liegt, dem die Stöchiometrie in Fleisch und Blut übergegangen ist und der bei allem, was er tut, von ästhetischem, dem Sinne für Ordnung und Sauberkeit, vor allem aber vom Streben nach Wahrheit geleitet wird.

That is in plain English:

> Successful inorganic-chemical [I add, organic and physico-chemical] investigations can only be carried out by such men as are not only theoretical chemists, but also perfect analysts, not only artisans with practical routine training, but thinking, plastic artists who have a deep insight into the theory of their experiments, who have stoichiometry at the tips of their fingers, who are always led by an aesthetic spirit for order and cleanliness, but above all by a desire for truth.

But too often the student feels inclined to complete the course which has been set him in the shortest time possible, without realizing that the way in which he completes his task must be considered of the greatest importance as regards his further attainments. He often shows little desire to repeat an unsuccessful experiment and does not appear interested in trying to better his results. And more than once we hear from those who wish to explain their lack of perseverance this excuse: "I prefer the theoretical side of chemistry to the practical."

The inclination to withdraw from experimental work in favor of speculative philosophy, to the great detriment of the scientific faculty, is especially noticeable in those students who early in their university career take up the study of philosophy. If the teacher of chemistry succeeds in convincing them that they are on the wrong road, and that a continuation of their scientific studies will give them equally great gratification, such episodes, when after a shorter or longer time the difficulties are vanquished, generally result in the student esteeming himself fortunate that he succeeded in checking his speculative inclinations at the proper time.

On the strength of these experiences I venture to warn against a premature study of speculative philosophy. If the natural philosopher, when he has won his way in scientific fields, feels inclined to enter the domain of speculative philosophy, he still may find an opportunity of following Mephisto's advice:

> Mein teurer Freund, ich rat' Euch drum
> Zuerst Kollegium Logikum
> Da wird der Geist Euch wohl dressiert,
> In spanische Stiefeln eingeschürt,
> Dass er bedächtiger fortan
> Hinschleiche die Gedankenbahn,
> Und nicht etwa die Kreuz und Quer
> Irrlichteliere hin und her.

Which runs in the English translation:

> For this I counsel my young friend
> A course of logic to attend;
> Thus will your mind, well-trained and high,
> In Spanish boots stalk pompously!
> With solemn look and crippled pace,
> The beaten road of thought will trace:
> Nor here and there, through paths oblique,
> In devious wanderings idly strike.

Then his critical judgment will enable him to turn to good advantage all that can benefit him in his further study in mathematical sciences.

Another possible error, of a totally different nature, is that he who devotes himself to practical laboratory work may have no eye for anything but his own experiments. The fact that in a laboratory a number of neophytes and more advanced students are at work together, on different, often totally divergent experiments, gives all of them an opportunity of paying attention not only to their own work, but also to the work of their fellow-students, of seeing and hearing what others do and of profiting by the mistakes and failures of their neighbors. It is a great advantage for the students if varied kinds of experiments are carried out in the same laboratory; the tendency now-

adays in some university laboratories to restrict the investigations to a narrow field is therefore not to be recommended.

No one can deny that the path of the prospective natural philosopher is beset with difficulties, or that he will meet with numerous reverses. But difficulties have their use; they stimulate the desire to overcome them. Thus the study of exact sciences exercises a beneficial influence on the formation of character in those who apply themselves to it with untiring zeal. The difficulties which the student must conquer steel his patience, and develop his perseverance, and his self-reliance, and when at last he has attained his end, he enjoys the peculiar satisfaction which indemnifies the genuine investigator for the most difficult labor and the greatest exertions. An advantage that can hardly be estimated at its true value is that such endeavors develop the sense of truth in a man. Has not the Swedish pastmaster in chemistry, Berzelius, declared: "Der erste und grösste Ruhm eines Forschers besteht in seiner Wahrhaftigkeit und Gewissenhaftigkeit; gegen diese gehalten, verschwinden alle wissenschaftlichen Verdienste." (The first and greatest glory of an investigator is his truthfulness and conscientiousness; all his scientific attainments are eclipsed by these qualities.)

You see, ladies and gentlemen, that a natural philosopher must have no mean qualifications if he wishes properly to perform the work he has undertaken. There are more and other qualities he must possess if he wishes to escape disappointments, but I can not enter into further details here. If you wish to go deeper into this subject, I refer you to the "Consolations in Travel or the Last Days of a Philosopher," by Humphry Davy, written down about a hundred years ago in his journey through Europe, and I advise you to read the fifth dialogue, which contains truths no less pregnant in 1926 than when they were set forth by the great British chemist.

We now turn to the third group of aids to the student, books of study. I think first of all of the question, "What text-book shall I use?" For the beginner I can recommend the use of one special text-book, so that the student gets acquainted with the elements of the science to be studied. But he should, as soon as possible, pass to the study of special subjects in special books. The choice is unlimited; the enormous increase of literature all over the world requires different subjects to be treated in monographs. Very often the scientist is obliged to turn to books written in some foreign language. This is, however, a great advantage to the student whose knowledge of foreign languages is generally below par, for it obliges him to go deeper into the study of these languages, and by using these books he develops greater linguistic proficiency.

The man who, later on, wishes to make the results of his researches known to a greater number of readers should be thoroughly conversant with one or more foreign languages. But in whatever language the text-books the student uses may be written, he should first of all learn to read with accuracy. The great majority, and experience has shown this very clearly, have had insufficient training in their earlier schooling. From what precedes, it follows that a library, however small it may be at first, is a "conditio sine qua non" for the earnest student. But inquiries on this point have taught me that the length of the bookshelves of most students can not be reckoned by meters, but by decimeters at most. If the student can not consult his own library, serious study is handicapped, for many reasons, one of which is loss of time if he has to borrow the books he needs.

The man who possesses a library of his own will have a better opportunity of studying chapters which for the moment are of no immediate use to him, and in this way he enlarges his views and his knowledge. I can not insist too much on the necessity of the student forming a library at his earliest convenience. He will never rue the money he spends on it. In this library he should find a place for books which treat of the history of science, as well as for those which I should like to call the "belles lettres" of science.

"Historische Studien gehören sehr wesentlich mit zur wissenschaftlichen Erziehung." (Historical studies are part and parcel of a scientific education.) Ernst Mach, with many others, has not only drawn attention to this fact, but, suiting the action to the word, has left us many an essay which bears witness to the truth of this statement. The man who studies the history of science will get a better insight into the problems that are nowadays a center of interest, nay he will also be convinced that:

> . . . es ist ein gross Ergötzen,
> Sich in den Geist der Zeiten zu versetzen,
> Zu schauen, wie vor uns ein weiser Mann gedacht.

> (. . . 'tis delightful to transfuse yourself
> Into the spirit of the ages past;
> To see how wise men thought in olden time.)

And when he reads the biographies of those "wise men" in which are described the ways in which knowledge was obtained, and in which the obstacles are shown which had to be conquered, he will learn to think humbly of himself and not overrate his own accomplishments. A large number of chemical and physical works are at his disposal in which great men, such as Ampère, Arago, Berthelot, Biot, Chevreul, Davy, Faraday, von Hofmann, Justus von Liebig, Edmund O. von Lippmann, Ernst Mach, Victor Meyer, Ramsay, Schönbein, Tyndall, to mention but a

few, have treated subjects, in or even outside the pale of the science they studied, in essays which excel in beauty of form and depth of thought and grip the attention of the reader by the striking way in which they confirm François Arago's words:

> La culture des sciences fortifie l'intelligence sans détremper les ressorts de l 'âme, sans émousser la sensibilité, sans attiédir aucune des bonnes qualités dont la nature a déposé le germe dans le coeur humain. (The pursuit of science strengthens the intelligence, without weakening the energy, without blunting the sensitiveness, without chilling any of the good qualities the germ of which has been placed in the human heart by nature.)

Great importance must be attached to the colloquia and student-lectures. The intention of the former is to encourage the advanced student to take cognizance of the latest results of science, and give him an opportunity to state his own views on the subjects which have more particularly drawn his attention. Thus he is obliged to acquaint himself at the same time with what was previously accomplished in this direction. If the prospective investigator wishes to be conversant with the progress of science, if he wants to know what problems are of actual importance, he must read one or more of the numerous periodicals which will inform him on this point and in which, at the same time, he can follow the evolution of science in cognate or more distant domains. The cardinal point of such studies is the fact that the student gets acquainted with the literature, that he learns to find his way in it, that he gains information about problems of which hitherto he was quite ignorant. In his later life he will often be required to find his way in a field of science where, up to that moment, he had never set foot. To prepare him for such contingencies is the first aim of the colloquia. The reading of his short paper trains him in logical formulation of ideas which continual practice only can give. This is of great profit to the man who chooses a scholastic profession, but no less to the manager of some industry who comes into contact with many persons of varying intellectual faculties to whom he must explain his ideas.

The student-lectures too aim at the development of the same qualities. Here the student is required to give his audience an insight, either into an up-to-date problem of which he has made a special study or into some problem of earlier times. The preparation of such an essay, the reading of which according to the well-tried prescription by Faraday should never take longer than one hour, acquaints the prospective lecturer with the literature of his subject. Let him never forget to consult "in originali" the books which refer him to the subject-matter in hand, neither when he prepares his paper for the student-lecture, nor when later on he publishes his investigations. He should never trust abstracts made by others, for many an investigation has been rendered totally worthless from the very outset because the author, a victim to indolence, had disregarded this precept. In the student-lectures, as well as in the colloquia, every one derives profit, not only from his own essay, but also from those of his fellow students, while the discussion on the subject widens their minds.

The first aim of the man who chooses the university as the place where he prepares for later life should be to get an all-round training in the science which he wishes to study. He does not always know what path he will choose when the gates of the university shall close behind him. Is he going to follow a scholastic profession, or a technical, or will he devote himself to a life of purely scientific study? It often happens that some predilection reveals itself during his stay at the university, and that in those years a fitness for some special career manifests itself. The great thing therefore is that his university course should be such as to allow him to defer for a time definite choice as to his subsequent career.

When we take all this into consideration, it would be very convenient if the university curriculum contained another item, *viz.*, excursions. By visiting and viewing certain chemical works the student gets a notion of the value of the applications of science. I say a notion, for he must not overrate the value of such excursions. From their very nature they can give him only a very vague idea of different industries. Their complicated nature, the short time which can be allowed for such visits, the secrecy which envelops, and very rightly, the plants visited, make a deep study of the matter an impossibility, even if the student has prepared himself by reading up books on the subject. It is of course a totally different matter if the prospective doctor chemiae can become acquainted with an industry by working in a plant for some time; a stay at a laboratory where special investigations are carried out (I have in mind the laboratories at some factories, as well as government agricultural stations and the like) can form an important element in his scientific training insofar as in such surroundings quick and accurate work is necessary. I need not point out that excursions as well as a prolonged stay at some factory can be of use to the more advanced student only.

Traveling during the university course in his native country would have many drawbacks, but when once the student has obtained his degree he must be enabled (at any rate the more talented) to go on an educational tour. Even if a prolonged stay in a foreign country should have no other effect than that the young doctor acquired fluency in the language of this country, the allowance granted would be well spent. For him who has eyes to see and ears to hear, the

advantages of an eduactional tour abroad are of incalculable value for his whole life. He is stimulated by the study of new methods of investigation, by coming into contact with younger men of another nationality whose ideas and sentiments are different from his. New relations and new friendships are contracted, perhaps for life. The man who has gone through such a period himself never gets tired of dwelling on the advantages and the pleasant memories he has kept of that time. And when he returns to his own country, after a stay in some centers of learning, he recognizes the truth of the old adage: "As many languages a man speaks, so many times he is a man." The plan which I have sketched here will be of benefit to our "itinerant" students, but no less to the laboratories they visit. Great is the influence which "outsiders" can exercise on the work in a laboratory. Their presence is an excellent remedy against the "humdrum routine" of the students and the "fads" of the professor.

When the student has taken his first degree, he enters upon the most instructive period of his studies, that is, if he wishes to conclude his college life with a doctor's degree. Up to this moment the examinations, though conducted in a very liberal and fair spirit, have exercised a certain constraint upon the study of the prospective doctor. Now, however, he can give his whole mind to a subject of his own choosing. This stimulates his energy, his perseverance; he is obliged to study the literature which bears upon his subject, and when at last he has completed his research, he must put his results into readable shape and work them up into a logical sequence, and all this is excellent training in the art of putting his thoughts to paper in a lucid and accurate form.

Let no one imagine that the course which I have sketched leads to the moulding of a scientist who satisfies every requirement of science or society. This is by no means the case. Remember that in the first part of this discourse I pointed out that the "Lehr- und Wanderjahre" of the student should make him not only a scholar, but also a man. I hope that I have made it clear that the way which leads to the forming of a scholar possesses more than one factor which can also play an important part in the forming of a man. The importance of other factors, however, should not be undervalued.

> Es bildet ein Talent sich in der Stille,
> Sich ein Charakter in dem Strom der Welt!

(A man of talent is formed in seclusion, a man of character in the whirlpool of life.)

The man who devotes himself exclusively to study, who keeps aloof from an environment such as only the university can give, who does not try to set his knowledge and gifts on a broader foundation by an intercourse with "all sorts and conditions of men," who does not try to give form and tone to his character, is wanting to himself and to society. Only by mixing with the different sets at the university does he find opportunity to exchange thoughts with fellow students whose intellectual horizon is quite different from his own: only thus will he guard against those qualities of self-consciousness and one-sidedness which can but harm him in later life.

Is it not a distressing sign of want of culture when, among students who already have spent some years at the university and have passed examinations there, some are found who do not know what the Nobel prize is, or who do not know even the names of those of their countrymen who have made themselves a great name in the science which these students have chosen for their own study? There is no better place for the prospective natural philosopher to learn that his subject embraces but a very small part of human knowledge than among the fellow-students of different faculties, and so he will be prevented from becoming overwise in his own conceit. In associations and debating clubs he finds another and perhaps a better opportunity of putting his thoughts lucidly and concisely into words. The discussions with others whose conceptions and opinions differ from his train him in self-command. Here is the arena where he prepares himself for life's struggles which await him after his college years. Here he finds an opportunity to develop the qualities which, together with his scientific attainments, will have such a great influence on his future happiness.

As early as the middle of the last century the Dutch author, Kneppelhout, whom I mentioned at the beginning of my discourse, justly made sport of the man who in later years should write a pompous and learned, and necessarily Latin work: "De methodo studendi optimo" (On the best Method of Studying). It has not been my purpose to give you such a manual, for I am of the same opinion as the author of "College-Life." There is no hard and fast rule which tells you how to become clever. There are more ways to the wood than one; in our case the special qualities of the individual are of the greatest importance in the choice of the way. It has been my aim to point out to you some paths which lead to the same goal. The paths differ from one another, but every one is free to take the road he likes best. But whatever path you follow, try to remember that it is always a steep mountain-road, the ascent of which is difficult, and that you will reach the top only if you exert yourself to the utmost. In so doing you will fulfil the hopes expressed by Andrew D. White, first president

of this university, carved on the granite gateway presented by him to Cornell:

So enter that daily thou mayest become more learned and thoughtful,
So depart that daily thou mayest become more useful to thy country and to mankind.

Ernst Cohen

Cornell University

SO-CALLED VOLCANIC EARTHQUAKES[1]

In considering the crustal mechanism that shakes the surface of the earth geologists seem to have adopted a convention or fashion, backed by honored names like Dana, Geikie and Suess, that relegates volcanic causes to the background. Volcanism to many teachers does not connote magma and substratum, but rather volcanoes and explosions. On the other hand, geanticlines and geosynclines, quite apart from anticlinoria and synclinoria in stratigraphic series, are drawn around the earth in long belts through every possible geologic structure and topographic obstruction under the magic of the word "tectonic." I have not found a single text defining the word "tectonic." Frankly, I do not know what it means. We are told that it is derived from a word meaning "roof." A roof is a structure protecting a void within. Tectonics involves "folding" into "forelands" whole strips of the earth's surface containing everything from gneiss to till and from granite to flowing lava, and from mountain ranges to a quarter of a continent. I am not mathematician enough to appreciate the geometry of folding a surface. If I might venture appositely to coin an equivalent word "volcanics," current texts would give the student to understand that volcanics involves explosion of steam mostly along ocean shorelines. Tambora and Krakatoa are the types; the earthquakes there are tiny and due to underground gases, and they are shallow and diminish a short distance away.

Modern volcanology is not in sympathy with these ideas. "Volcanic earthquakes" have no more meaning than "tectonic" ones. The volcano is not the seat of volcanism. The volcano is the least part of the process the volcanologist is interested in. The explosion is the part least volcanic of the very small part of volcanism that the volcano represents. I am speaking volumetrically.

What modern volcanology is interested in primarily is the under heat and the juvenile gas of the earth crust, the identity of that crust, thermal phenomena of geophysics wherever found and wherever measurable, kinetic phenomena of all sorts which can be considered fundamentally thermal, and measurable gradations athwart the land and vertically downward (and also athwart that seventy-two per cent. of the surface called sea-bottom), which will lead by quantitative measurement to sound and reasonable theory concerning magmatic intrusion in progress to-day. This and this only is the reason for studying active volcanoes, in order to find gradations away from them in measurable process. The processes measurable are primarily heat evolution, juvenile chemistry, seismicity, visible magmatic emission, gravity and terrestrial electric fields. All sorts of devices are possible by way of method. The science is essentially experimental because untouched. Seismology and geodesy have provided solid ground for belief in a crust and in a more mobile substratum. The geology of igneous rocks undeniably exhibits them everywhere in depth.

The earth's crust and the under stratum of magma are necessary for the concept of isostasy. Bowie, Sandberg and others have come to the conception of thermal isostasy. The crust is in balance. The disturbance of balance may arrive below by intrusion or cooling, or above by erosion and accumulation of sediment. The balance is a fact. Volcanology must measure the disturbances, assisted by all the other branches of geophysics. If the balance is a fact, and magma is a fact, and crust is a fact, and magma moves at volcanoes, and the crust moves as proved geodetically within decades and seismometrically within hours, there seems no possible doubt of the fact that magma moves at places where volcanoes have long since been buried and replaced by intrusion, or even where volcanoes of modern type have never existed. These motions just as much concern volcanology as volcano movements.

Gradations of volcanicity across country are exactly what are found and cited by the authorities as being non-volcanic. In Montessus de Ballore's "Geologie Sismologique" of 1924, page 225, the diminution of seismicity from north to south in Chile with increase of volcanic eruption in that direction is cited as proving that the earthquakes are "non volcanic." And in time the increase of earthquakes when volcanoes become quiet proves that earthquakes are "non-volcanic." No reasoning could possibly seem more fallacious to one who thinks of volcanism as dominantly intrusive.

If one examines the facts of these gradations in the world, the more one is impressed by both time and place evidence, that as crust thickens over magma and outflow of lava disappears, the seismic centers become

[1] Paper presented before the American Association at Kansas City, December 29, 1925, as part of a symposium on earthquakes.

deeper, the thermal manifestations change from boiling springs to warm springs, the seisms become fewer but perhaps stronger, the area over which these are perceived becomes larger, probably geodetic level and creep change becomes smaller and more widespread, and in large-scale sequences across continents the geologic formations and deformations become older.

Examples of such gradation are the change cited from seismic north to volcanic south in western South America; from seismic south to volcanic north in California; from volcanic Aleutian Islands to seismic Mount McKinley; from volcanic Java to seismic Sumatra; from volcanic Tertiary to seismic modern in most of the volcano districts of the world; and across the United States from east to west from deep volcanic and deep seismic at the east to shallow or active volcanic and seismic at the Pacific coast, with much higher thermal gradients. Across the United States also we pass in general from older to younger deformations.

It is precisely because of such gradations and because of isostatic adjustment as conditioning process that it seems reasonable to consider heat and magma as conditioning the causes of big earthquakes. This would be through intrusive flow, gas expansion, change of volume by water acquisition or crystallization, deep-seated engulfment accompanying "stoping," thermal effects on the environing rocks and every other possible magmatic motion conditioning pressure, *except* volcanic eruption, subterranean explosion or "collapsing steam." No volcanologist would seriously consider any of these last as having any bearing on the earthquake problem whatever.

T. A. JAGGAR
HAWAIIAN VOLCANO OBSERVATORY

NEW YORK CITY AS A FIELD FOR EARTHQUAKE STUDY[1]

THE modern seismograph has been developed during the last thirty-five years. Within this period, the study of earthquakes has passed from a more or less speculative phase to a quantitative study of the phenomenon. In 1912, two 450 kilogram components of a Mainka seismograph were installed in the American Museum of Natural History, New York. Numerous earthquakes have been recorded on these instruments during the past thirteen years, but the greater number of the disturbances have been distant quakes which originated thousands of miles from New York. Nearby quakes have also been recorded, but most of them have been so faint that they were not felt by citizens of the city. Those of February 10, 1914, and February 28, 1925, which originated in eastern Canada, were felt, however, by a large number of the inhabitants of New York City and the northeastern United States. Although the metropolis is considered to be immune from earthquakes by a large number of scientists and laymen, the above brief résumé indicates that it is advantageous to have seismograph stations in New York City. There are two stations at present, one at Fordham University, and the other at the American Museum of Natural History.

In an earthquake record, or seismogram, we are concerned with the mechanical effects propagated from the region in which the earthquake occurred. Astronomical and seismological theory demand a solid earth with more or less uniform physical properties for the propagation of the earth waves. The wave effects on a seismogram of a distant earthquake may persist for several hours, although at the point of origin they may last for only a few seconds. On such a record three principal phases of types of waves, corresponding to the longitudinal, transverse and long waves, may be noted. The first two types travel by the shorter way, through the earth, and the third type around the earth's surface. The initial portion of the record will be recognized as the longitudinal waves or first preliminary tremors. These waves are of short period, small amplitude and tend to die down preceding the arrival of the transverse waves of second preliminary tremors, which are of longer period, quite irregular and of greater amplitude. The relative duration of these first two types of waves on the record is dependent upon the distance, the greater the distance the longer the time involved. The third type, or long waves, have a much greater amplitude and assume a strongly periodic and sinusoidal character. For distances greater than two thousand kilometers the first phase is indicated by a few waves with a period of about twenty seconds which gradually increase in amplitude. This phase is followed by a rapid development of extremely smooth waves of rather shorter period which reach a maximum amplitude, subside and pass through a succession of maxima before merging into the tail portion of the earthquake.

In nearby earthquakes where the distance is less than one thousand kilometers the preliminary waves are very much abbreviated and not well resolved into the two distinct phases.

The curved surface of the earth introduces many diffraction effects into the seismogram. These features start immediately after the P and S waves or first preliminary and second preliminary tremors begin, and are referred to as PR_1, SR_1, etc. With a whole series of diffraction effects in addition to the P and S features the earthquake record becomes com-

[1] Paper presented at Kansas City, December 29, 1925, as part of a symposium on earthquakes.

plex and difficult to read. Seismograms are not alike since no two earthquakes of like intensity originate in the same place.

Greatly improved time curves and tables giving the time of arrival of the first preliminary and second preliminary waves as functions of the epicentral distance were developed by Zeissig and later modified by Klotz. The Klotz tables, which were published by the Dominion Observatory at Ottawa, 1916, give the epicentral distance for the time interval between the arrival of the P and S, PR_1 and SR_1 waves. They are extensively used at the seismological stations in the United States and Canada for determining the distance from a station to the point of origin of an earthquake.

The location and the distribution of earthquakes reveal the present zones of maximum change in the strained lithosphere or solid part of the earth. Reeds' seismic map of the world, published in *Natural History,* New York, Vol. XXIII, p. 466, 1923, which gives the location of 276 major earthquakes for the period 1899 to 1911, shows the close association of recent earthquakes to the belts of sedimentation, dominant folding and mountain uplift during the Cenozoic era. The earth's crust trembles predominantly along two narrow zones which lie along two great circles of the earth known as the Alpine-Caucasian-Himalayan circle and the circum-Pacific circle. Modern seismographs now record the sudden major movements of the earth's crust quite independently of whether they occur on land or at sea.

A thousand earthquakes have been noted in eastern North America since the settlement of the country by Europeans. Most of these quakes were slight, but a few were violent, such as those of February 5, 1663, and February 28, 1925, in eastern Quebec Province, Canada. They occurred singly and in groups, the more prominent aggregates being 1730–1740 and 1860–1870. From July, 1924, to July, 1925, sixteen earthquakes were noted in the United States and southern Canada. Of this number, twelve were developed east of the Great Lakes. The St. Lawrence, the Montana and the Santa Barbara quakes were the most violent. The Alberta and Montana temblors were interesting in that they were the first recorded for those areas. All except the very smallest of these disturbances were recorded on the seismograph at the American Museum of Natural History.

In a local study of earthquakes it is well to note the character of the rocks, their periods of deformation, whether past or present, and whether the structure is homogeneous or broken by numerous faults. In regions which are being uplifted, faults are important in that most earthquakes are produced by sudden displacements along them.

In the metropolitan district of New York the rocks belong to five distinct geologic ages and are disposed in belts which trend in a northeast-southwest direction. The oldest constitute the crystalline basal complex and extend to unknown depths. They are regarded by local geologists to be of pre-Cambrian age. Old fault lines with different periods of development have been observed in these rocks where detailed geological studies have been made.

In northeastern New Jersey a younger series of rocks of Triassic age, which are referred to as the Newark series, occupy the downfaulted earth block between the Reading prong of crystalline rocks on the northwest and the Manhattan Island prong on the southeast. They consist of reddish conglomerates, sandstones and shales and some four flows of intruded black basaltic rocks—altogether they are about three and one half miles in thickness. The northwestern margin of the Newark basin is bounded by a great fault, as noted by the sheer face of the Ramapo Mountains in the vicinity of Suffern, New York; the structure of the region suggests that the southeastern margin of this basin is marked in the same way, but it is not definitely known, for it is concealed by the bed of the Hudson River. Numerous smaller faults also occur within the northwesternly dipping beds of the Newark series.

Faulted and tilted Triassic rocks also occur in two areas to the northeast of New York City. One of these extends northward from New Haven, Connecticut, to Hartford, and up the Connecticut River valley to the northern boundary of the state of Massachusetts. The graben structure of this district, with its faulted margins, and its dislocated blocks of "red beds" and volcanic rocks, constitute features that are not only well known from a geologic point of view, but according to historical accounts the region has been frequented by numerous small earthquakes.

The other area extends southwestward from Nova Scotia and the Bay of Fundy across the floor of the Gulf of Maine towards Boston, Massachusetts. The Triassic rocks of Nova Scotia have been known for some time, but it is only recently that the probability of the floor of the Gulf of Maine as a faulted area has been brought to our attention by Professor D. W. Johnson. These supposed faults afford a possible source for the rather frequent minor earthquakes that have occurred recently, and in historical times, at Boston, Lowell, Newburyport and other points along the New England coast.

Rocks younger in age than the Triassic occur on the seaward side of the crystalline belt in New Jersey and Long Island. They consist primarily of an alternating series of sand and clay strata. They conceal the older rocks and, so far as known, are not broken by lines of dislocation, although they have

been tilted seaward by repeated uplifts of the land in Cenozoic times.

The last and one of the most interesting groups of rocks with which we have to deal are the glacial drift deposits which were left on the surface of the ground throughout New England, New York and to the westward, as the ice of the successive Pleistocene glaciations retreated northward from Staten Island and Long Island. These deposits consist of unsorted sands, gravels, boulders and in certain basins of beds of clay. They vary in thickness from zero to two hundred feet.

Following the retreat of the ice of the last glaciation northward the entire landscape of eastern North America, including the old rocks and the early post-glacial lacustrine and fluvatile sediments were differentially uplifted. As noted by Leverett, Taylor, Goldthwait, Fairchild and others, the uplift varies from zero elevation, in the vicinity of Asbury Park, New Jersey, to one thousand feet about one hundred miles north of Quebec, Canada. Recent studies by the writer on the varve clays and the glacial lakes in the vicinity of New York City have confirmed this upwarping of the land surface in Postglacial time, and determined the average rate of uplift to be approximately two and one quarter feet per mile.

This differential uplift of the land, following the melting of the Quebec ice cap, suggests very strongly that the ice mass during its maximum extent was not only very thick, but that it was of great weight, and that it affected the isostatic balance of eastern North America during its advance and following its retreat. The thickness of the ice near its margin could not have been more than a few thousand feet, perhaps half a mile, which would mean a weight of two billion tons per square mile. The ice must have reached its greatest thickness in the region where the post-glacial elevation has been greatest, namely: to the north of Quebec. There the ice must have been two miles thick with a weight of eight and a half billion tons resting on each square mile. It is reasonable to suppose that post-glacial changes in elevation could not have taken place without developing stresses and strains in the rock mass, and it is natural to infer, from our present knowledge of seismology, that periodic relief from these causes was found by sudden adjustments along fault lines producing earthquakes.

Professor J. B. Woodworth, in discussing the "Post-Glacial Faults of Eastern New York" in 1907, calls attention to twelve districts in eastern North America where glaciated surfaces on crystalline rocks show numerous small step faults with individual displacements of from one to seven inches. The areas noted are Troy, Defreestville, Rensselaer, Pumpkin Hollow, Copake, Long Pond and Hyde Park, New York; Attleboro, Massachusetts; Kilburn Crag, New Hampshire; and St. Johns, New Brunswick; and two areas in southern Quebec Province, Canada. In Troy, New York, instances are cited by Woodworth where buildings situated over these faults have cracked and displaced walls.

The retreat of the ice of the last glaciation has been so recent, geologically speaking, that the writer is of the opinion that the post-glacial uplift of the land has not yet ended, and that the numerous slight earthquakes which have been recorded in eastern North America during the last four centuries, together with those which are now being recorded on seismographs, are indications that the isostatic balance of this region has not yet been reached, and that New York and other cities in eastern United States and Canada are still subject to these local quakes. The more prominent of these recent earthquakes occurred as follows:

On February 10, 1914, an earthquake was felt in numerous places along the St. Lawrence River, throughout eastern New York state and as far south as Philadelphia. According to the late Otto Klotz, of the Dominion Observatory, the epicenter of this earthquake was 120 kilometers or seventy-five miles northeast of Ottawa, Canada, and the estimated depth of its hypocenter eighty-three kilometers or fifty-three miles below the surface of the earth. This earthquake was recorded on the seismograph at the American Museum of Natural History.

On September 30, 1924, a slight earthquake which was felt in the Aroostook Valley, Maine, was recorded on the seismograph at the American Museum from 3:57 A. M. to 4:00 A. M. eastern standard time. This was followed by other quakes in New England and Quebec on January 7, February 28, March 7, March 20, April 24 and 27, and May 12, 1925. Of these the St. Lawrence earthquake of February 28, 1925, at 9h 19m 20s P. M. eastern standard time, was the most severe. It was felt over eastern Canada and the New England states, and as far south as Virginia, and as far west as the Mississippi River. According to Professor E. A. Hodgson, in an article published in the *Bulletin* of the Seismological Society of America, Vol. 15, 1925, the damage done by this quake was confined to a narrow belt covering both sides of the St. Lawrence River. The epicenter was located in latitude 47° 45′ N. and longitude 70° 30′ W., that is, about half way between Murray Bay and Chicoutimi, Quebec Province, Canada.

In conclusion, it may be stated that the seismographs indicate that no perceptible earth movements have taken place along the old fault lines in the crystalline rocks underlying New York City within the past decade nor in the faulted Triassic area to the

west in New Jersey. There are some indications that slight disturbances have arisen in the Triassic belts of the Connecticut Valley and the Gulf of Maine, but these may be associated with the post-glacial uplift of eastern North America which is evidently still in force, if we may judge from the fact that the larger of the nearby earthquakes have occurred in those areas where this uplift has been greatest, namely, in Quebec Province, Canada. As New York City is situated near the southern margin of the territory covered by the last ice sheet and as the post-glacial changes in elevation have been comparatively slight there, no earthquakes have arisen within the city limits, nor are they likely to occur. Tremors, generated by quakes arising in New England and to the northward may be felt, however, within the city, particularly in those portions built on made land or unconsolidated sediments. It may be said, therefore, that the New York City district is for the most part an aseismic area and offers an excellent field for the instrumental study of distant and nearby earthquakes.

Chester A. Reeds

American Museum of Natural History

WILLIAM E. SAFFORD

Death has recently taken from the United States Department of Agriculture one of its most brilliant men, whose place in the agricultural world will be extremely hard to fill.

Dr. William E. Safford, for many years an expert botanist in the Bureau of Plant Industry, died in Washington, D. C., in the latter part of January after an illness of over a year, which kept him confined closely to his room.

During all the months he was ill Dr. Safford worked regularly on two books which he wanted to finish and leave as an appropriate ending to his life labors. I understand the MSS was practically completed before he passed away.

Dr. Safford was one of the most genial, wide-awake men it has ever been my good fortune to know. He was interested in everything. A musician; an artist; a world-known writer on plants and agricultural topics of every kind; a wonderful linguist; frank and boyish in his manner; a friend of every one and every one his friend; a loving husband and parent: this is the man we all knew and loved. He was born in Chillicothe, Ohio, in 1859 and graduated from Annapolis Naval Academy in 1880 with high honors. The education given a naval officer at Annapolis is conceded to be the most thorough of any educational establishment in this country, along with West Point, but Safford was not satisfied. In 1883 he took post-graduate studies in botany and zoology at Yale and later in 1885 marine zoology at Harvard. In 1920 he was given his degree of Ph.D. at George Washington University at Washington.

While in the navy he was always deeply interested in scientific botany and marine zoology. He was probably the foremost expert on the seed foods and food plants of early pre-Columbian inhabitants of this continent and contributed many important bulletins and papers on these subjects. Mr. Safford was a prolific writer and has left a large list of publications on many scientific subjects as a record of his tremendous industry.

While still in the navy he was for two years naval governor of the Island of Guam and wrote several interesting books on the people and plants of the little known island.

He had a remarkable command of languages, being frequently called upon by the state and other government departments at Washington to help entertain distinguished foreign guests. He spoke with great fluency several of the tongues of South American countries.

In his home life Dr. Safford was most happy. He idolized his wife and two fine children, a boy and a girl, whom he left to mourn his loss.

He will be sadly missed in social and scientific circles of the National Capital.

At the time of his death Dr. Safford was economic botanist in the Bureau of Plant Industry in the United States Department of Agriculture—a position which he had held for almost twenty years with distinguished success.

It is a most unfortunate fact that the farmers and stockmen of this country know so little of the important work done by such scientists as Mr. Safford and his fellow worker in the department, Charles V. Piper, recently deceased. These two men devoted almost their whole lives to the study and development of pasturage and range plants and general agricultural forage crops in the United States. It is a great pity that the scientfiic work of this kind which has been done by men such as Safford and Piper is generally carried on so quietly and with so little blowing of trumpets as to be almost unnoticed by the everyday world.

This, however, seems to be the fate of the scientific investigator and student. The agricultural and pastoral interests of this country owe much to Mr. Safford for his work in their behalf. May his memory ever be kept green by those who like myself have profited greatly through knowing him.

Will C. Barnes

Forest Service, Washington, D. C.

SCIENTIFIC EVENTS

DEVELOPMENT OF THE BIOLOGICAL LABORATORY AT COLD SPRING HARBOR

The Long Island Biological Association has recently acquired thirty-two and one half acres of land for the Biological Laboratory at Cold Spring Harbor, Long Island. The land is situated to the north and west of the previous limits to the laboratory grounds. It is admirably suitable for its proposed uses; namely, to provide building sites for the immediate expansion of the biological laboratory and for biologists who desire to establish their summer homes at Cold Spring Harbor in close proximity to the laboratory and its available facilities for biological study and investigation.

The present plans call for expansion of the laboratory to the north of the buildings on an excellent parcel of land having a frontage of over four hundred feet on Cold Spring Harbor.

Directly west of this parcel, and of the previous holdings, the land rises in a series of beautifully wooded terraces to an elevation of about one hundred and fifty feet above sea level. All of these terraces command a pleasing view of the harbor, while from some there is a panorama which includes portions of Long Island Sound and of the Connecticut shore. These terraces are available for purchase by biologists. Detailed information will be furnished upon application to R. G. Harris, director of the Biological Laboratory.

The acquisition of the land was made possible by the generosity of some sixty officers and members of the Long Island Biological Association who contributed $65,000 for this purpose.

At the same time with the purchase of the land for the biological laboratory, nine acres from the same original tract (41.6 acres) were purchased by the Carnegie Institution of Washington to help connect the two sections of the department of genetics. This was made possible by gifts from a number of friends of the institution as well as by a special appropriation by its trustees.

THE MELLON LECTURES AT THE UNIVERSITY OF PITTSBURGH

The eleventh Mellon Lecture before the Society for Biological Research of the school of medicine of the University of Pittsburgh will be given by Dr. G. N. Stewart, professor of experimental medicine at Western Reserve University, on April 30. The subject of the lecture will be "Studies on the Adrenal Gland."

The income from an endowment fund provided by Mr. R. B. Mellon, of Pittsburgh, Pa., placed at the disposal of the society for biological research, enables the society annually to invite some eminent investigator in the medical sciences to deliver a lecture before the society. Previous Mellon lectures have been given as follows:

1915. Professor John J. Abel, professor of pharmacology in Johns Hopkins University. "Experimental and Chemical Studies of the Blood with an Appeal for More Extended Training for the Biological and Medical Investigator."

1916. Dr. Theobald Smith, director department of animal pathology, Rockefeller Institute for Medical Research, Princeton, N. J. "Certain Aspects of Natural and Acquired Resistance to Tuberculosis and their Bearing on Preventive Measures."

1917. Professor Otto Folin, Hamilton Kuhn professor of biological chemistry, Medical School of Harvard University. "Recent Biochemical Investigations on Blood and Urine; Their Bearing on Clinical and Experimental Medicine."

1918. Professor Robert W. Lovett, John B. and Buckminster Brown professor of orthopedic surgery, Medical School of Harvard University; Major Medical Reserve Corps, U. S. A. "The Problem of Reconstruction and Re-Education of the Disabled Soldier."

1920. Major General W. C. Gorgas, U. S. A., late surgeon general, U. S. Army, chairman Yellow Fever Commission, International Health Board. "Yellow Fever, illustrating the Application of Modern Sanitation and Preventive Medicine in the Control of Epidemic Diseases."

1921. Dr. Robt. McCarrison, lieutenant-colonel, Indian Medical Service, Pasteur Institute, Coonoor, Madras, India. "Faulty Food in Relation to Gastro-Intestinal Disorder."

1922. Sir Thomas Lewis, physician to the staff of the Royal Medical Research Committee and physician and lecturer in cardiac pathology, University College Hospital, London. "Interpretations of the Initial Phases of the Electrocardiogram with Special Reference to the Theory of 'Limited Potential Differences.'"

1923. Dr. David Marine, director of laboratories, Montefiore Hospital, New York City. "The Importance of our Knowledge of Thyroid Physiology."

1924. Professor Thomas Hunt Morgan, professor of experimental zoology, Columbia University, New York City. "Human Inheritance."

1925. Dr. Frank B. Mallory, pathologist to the Boston City Hospital. "Hemochromatosis and Chronic Poisoning with Copper."

GRANTS FROM THE ELIZABETH THOMPSON SCIENCE FUND

Previous awards from the Elizabeth Thompson Science Fund have been reported in Science, March 16, 1923, p. 321; August 17, 1923, p. 119 and

February 8, 1924, p. 142. Since the last report the following awards have been made:

At the Meeting of February 28, 1924

No. 257 to Dr. B. Lipschutz, Paltauf's Pathological Institute, Vienna, Austria, $150 for continuing his studies of the experimental tar cancer of the mouse.

No. 258 to Alexander Petrunkevitch, Yale University, $100 toward the expenses of collecting Arachnids.

No. 259 to Alfred C. Kinsey, University of Indiana, $200 toward expenses on his work with gall wasps.

At the Meeting of May 28, 1924

No. 260 to Bela Pogény, Budapest, Hungary, $80 toward researches in the propagation of light in moving bodies.

At the Meeting of November 28, 1924

No. 261 to Arthur F. Scott, Reed College, Portland, Oregon, $75 for purification and analyses of nitrosyl chloride.

No. 262 to F. A. Hartman, University of Buffalo, $200 to compare effects produced by muscular exercises in normal animals with those that take place under various conditions of endocrine insufficiency.

No. 263 to Grinnell Jones, division of chemistry, Harvard University, $300 toward the purchase of apparatus necessary for the determination of the absolute value of the electrical conductivity of solutions.

At the Meeting of February 27, 1925

No. 264 to Linda B. Lange, School of Hygiene and Public Health, Johns Hopkins University, $200 to aid in investigations on cutaneous sensitization to tuberculin in guinea pigs.

No. 265 to R. R. Renshaw, Havemeyer Chemical Laboratory, New York University, $200 to aid in investigations on correlation between chemical constitution, physical properties and physiological action.

No. 266 to George H. Shull, department of biology, Princeton University, $180 for the purchase of lime to correct the acid in soil in his experimental garden and greenhouse.

At the Meeting of May 28, 1925

No. 267 to K. Stolywho, Anthropologic Institute, Warsaw, Poland, $300 for anthropological investigations in Poland.

No. 268 to H. M. Chadwell, Tufts College, not to exceed $200 to assist him with mechanical appliances for calculations involved in his chemical investigations.

At the Meeting of November 26, 1925

No. 269 to Duncan S. Johnson, botanical laboratory, Johns Hopkins University, $300 toward traveling and collecting expenses in Jamaica and Porto Rico, and for further studying in Baltimore of the development of the seed and especially the persistent fruits of the Myrtaceae.

At the Meeting of February 25, 1926

No. 270 to Charles E. Simon, School of Hygiene and Public Health, Johns Hopkins University, $200 toward the cost of purchase and maintenance of animals necessary for a study of the infectious sarcomas.

The trustees of the Elizabeth Thompson Science Fund meet during the last ten days of the months of February and May and November. Applications for grants should be sent in well in advance of the meetings to the secretary of the fund, Dr. Edwin B. Wilson, 55 Van Dyke Street, Boston, Mass.

RESIGNATIONS IN THE DEPARTMENT OF DERMATOLOGY AT COLUMBIA UNIVERSITY

According to press reports, twenty-six members of the staff of the department of dermatology of the Vanderbilt Clinic and the College of Physicians and Surgeons of Columbia University have resigned within the last week. Only three or four have retained their positions in this department.

The resignations took place because the Faculty of Medicine of the College of Physicians and Surgeons of Columbia did not select Dr. George M. MacKee, the senior member of the department, to succeed Professor John A. Fordyce, the head of the department, who died last year. The faculty selected Dr. Joseph Gardner Hopkins, who had been an assistant of Dr. MacKee. Dr. Hopkins is a bacteriologist and roentgenologist with a training in scientific research.

A member of the governing organization said that broad scientific training was the first thing which the faculty sought in appointing new men to important medical posts. He said, however, that Dr. Hopkins combined considerable clinical experience with high scientific attainment; that his general qualifications made him the best equipped man for the place and that he was expected to improve the department.

The resignations, it was said, would not change the intentions of the faculty. None of the resignations has been considered as yet, it was said, and no vacancies filled. It was denied that the faculty failed to appreciate the value of clinical experience.

The announcement of the resignation of Professor MacKee and the twenty-five others was made simultaneously with the announcement by Columbia University that Professor MacKee, who has been an

assistant professor, had been raised to a full professorship in the department of dermatology. This honor that was conferred on Professor MacKee, however, left him under the orders of his own former subordinate, Dr. Hopkins.

The others who resigned were Professors Fred Wise and Isadore Rosen, and Doctors J. J. Eller, E. C. Jagle, Max Scheer, E. W. Abramowitz, David Bloom, Harry Saunders, D. Ballin, D. Satenstein, Charles Lerner, S. Strumwasser, M. Standish, E. D. Newman, B. Berkowitz, H. Norton, Frederick Amshel, F. X. Wilhelm, Lotta Myers, J. P. Thornley, S. Littenberg, John Harris, Van Alstyn Cornell, Louis Tulipan and John Remer.

An unsigned statement was sent out purporting to describe the position of those who resigned, which read as follows:

With the exception of two or three physicians, the entire staff of the department of dermatology and syphilis, of the Vanderbilt Clinic and the College of Physicians and Surgeons of Columbia University, over thirty physicians have resigned from the institution.

This action was taken as a protest against the policy of the university authorities. This policy consists of placing physicians whose training has been obtained in laboratories—with test tubes and guinea pigs instead of human beings with diseases—at the absolute head of large clinical departments. It is the opinion that this policy is ruthless and arrogant in that it disregards obligations and consequences. The policy has been tried in other departments of the Medical College, as well as in other institutions, and has been found wanting.

It is the consensus of opinion among the best minds in American medical circles that the policy is opposed to the best interests of medical education and that it is especially detrimental in the specialty embracing dermatology and syphiology, in which clinical training and clinical teaching are paramount. Knowledge of laboratory technic is a relatively unimportant feature in the teaching of these subjects, and in the treatment of patients afflicted with skin diseases and syphilis. Doctors in this field must be clinicians first and last, not laboratory experts.

THE MADRID MEETING OF THE INTERNATIONAL GEOLOGICAL CONGRESS

Following is a list of American geologists who expect to attend the International Geological Congress to be held in Madrid, Spain, from May 24 to 31, 1926. There will be excursions before the formal opening of the congress, the first of which will take place on May 5.

Alcock, F. J., Geological Survey, Ottawa, Canada.
Ashley, George H., and wife, State Capital, Harrisburg, Pa.
Ami, Henry M., Geological Survey, Elgin Annex, Ottawa, Canada.
Bain, H. F., wife and daughter, Sec. A. I. M. and M. E., 29 W. 39th St., New York City.
Bateman, Alan M., and wife, Yale University.
Bonine, C. A., Pennsylvania State College.
Bruce, E. L., Queen's University, Ontario, Canada.
Cleland, H. F., England.
Cobb, Collier, University of North Carolina.
Coleman, A. P., University of Toronto.
[1] Cooke, C. W., U. S. Geological Survey.
De Wolf, F. W., Mason Building, Houston, Texas.
D'Invilliers, Edward V., and family, Cannes, France (Villa Lochabair, Chemin de Provence, care of Mrs. J. P. Holt).
Darton, N. E., U. S. Geological Survey.
Fairibault, E. R., Canadian Geological Survey.
Fenneman, N. M., University of Cincinnati.
Fergudon, H. G., and wife, U. S. Geological Survey.
Field, R. M., Princeton University.
Gardner, Dr. Julia, U. S. Geological Survey.
Goldman, M. I., and wife, U. S. Geological Survey.
Hall, G. M., U. S. Geological Survey.
Harris, G. D., and wife, Cornell University.
Hewett, D. F., and wife, U. S. Geological Survey. (Sailed March 12.)
Jacques, Miss L., U. S. Geological Survey.
Kemp, J. F., and wife, Columbia University.
Keyes, Charles R., 944 Fifth Ave., Des Moines, Iowa.
[1] Lahee, F. H., Sun Oil Co., Dallas, Texas.
Latimer, Miss N. E., U. S. Geological Survey.
Lawson, Andrew C., University of California. (Abroad now.)
Leith, C. K., and wife, University of Wisconsin.
Mathews, E. B., and family, Johns Hopkins University. (Sailed February 27.)
Merrill, Geo. P., U. S. National Museum.
Miller, Benjamin L., Lehigh University.
Moore, E. S., wife and daughter, University of Toronto.
Noble, Levi F., and wife, Valyermo, Los Angeles Co., California.
Palache, Charles, Harvard University. (Sail May 8.)
[1] Penrose, R. A. F., Jr., Bullitt Building, Philadelphia, Pa.
Powers, Sidney, Amerada Petroleum Corp., Tulsa, Okla.
[1] Petty-Dabney, E., 10 Tenth St., San Antonio, Texas.
Quirke, T. T., University of Illinois.
Scott, William B., Princeton University.
Sellards, E. H., University of Texas.
Singewald, Joseph T., Jr., Johns Hopkins University.
[1] Soper, G. W., 1401 Cowper St., Palo Alto, Calif.
[1] Stose, G. W., U. S. Geological Survey.
Thom, W. T., Jr., U. S. Geological Survey.
[1] Udden, J. A., University of Texas.
Ulrich, E. O., U. S. National Museum.
Walker, T. L., Montreal.
[1] Weaver, Charles E., University of Washington.
Wilson, M. E., U. S. Geological Survey.
Wrather, W. E., and wife, 6044 Bryan Parkway, Dallas, Texas.

[1] Hope to go but not yet certain.

SCIENTIFIC NOTES AND NEWS

DR. EDGAR F. SMITH, professor of chemistry at the University of Pennsylvania, has been awarded the second Priestley medal, bestowed every three years by the American Chemical Society upon a chemist for outstanding achievement in the science. The first Priestley medallist of chemistry was Ira Remsen, former president and professor of chemistry of the Johns Hopkins University. The presentation to Dr. Smith will be made at the Philadelphia meeting of the society next fall.

JOHN M. COULTER, of the Boyce Thompson Institute for Plant Research, has been elected a corresponding member of the Peking Society of Natural History, an organization established in 1925, and containing now over 100 of the leading scientists of China. During 1923, Dr. Coulter lectured in the leading universities of Central and Northern China.

PEDRO SANCHES, of Mexico, who was recently awarded the Cullum gold medal of the American Geographical Society in recognition of his services in map making, was formally presented with the medal by Ambassador Sheffield on April 12.

CLARENDON IONS, an amateur astronomer now of Miami, Florida, and director of the Southern Cross Observatory located at Miami, has been elected a fellow of the Royal Astronomical Society of Great Britain.

A MOUNTAIN in eastern Canada has been named for Professor J. Franklin Collins, of the U. S. Bureau of Plant Industry. Professor Collins was a member of a party of American botanists which in 1923 made a trip into the interior of the Gaspé Peninsula in eastern Quebec for the purpose of exploring botanically that unmapped region.

THE semi-reclining marble statue of Professor Ramón y Cajal was recently unveiled in the Madrid park. It stands on a high rectangular pedestal in the center of a square pool fed by two fountains. The rear wall of the pool towers higher than the statue and bears bronze inscriptions and a bronze life-size figure of wisdom.

SIR JOHN ROSE BRADFORD has been elected president of the Royal College of Physicians of London.

SIR HAROLD STILES, professor of clinical surgery at the University of Edinburgh, has been elected into the Athenaeum, under Rule II of the club, for distinguished eminence in science.

M. LEON GERARD, well-known Belgian electrical engineer, was appointed an officer of the Leopold Order on the recent occasion of the twenty-fifth anniversary of the establishment of the first three-phase electricity distribution system in Belgium.

DR. R. KIENBÖCK, professor of medical radiology at Vienna, has been elected a corresponding member of the Radiological Society of North America.

DR. WILLIAM EWART GYE has been awarded the Walker prize of £100 from the Royal College of Surgeons for his work on cancer.

THE trustees of Princeton University have voted to continue in active service for two more years Professor William Berryman Scott, head of the department of geology, and Professor Leroy Wiley McCay, of the department of chemistry, both of whom reach the compulsory retiring age this year.

PROFESSOR HERBERT E. GREGORY, of the department of geology at Yale University, who has spent half of each year as head of the Bishop Museum of Honolulu, will, for the next three years, devote all his time to directing its activities.

DR. FREDERIC A. LUCAS has retired from active duties as director of the American Museum of Natural History. At a recent meeting of the trustees he was made honorary director, and in this capacity he will continue active work. George H. Sherwood, formerly executive secretary of the museum, has been appointed acting director for a period of two years.

JOHN E. GRAF, entomologist in charge of truck crop insect investigations, U. S. Bureau of Entomology, has been appointed a member of the Federal Horticultural Board to fill the vacancy caused by the death of Dr. W. D. Hunter. The other members of the board are: C. L. Marlatt, *chairman;* George B. Sudworth, M. B. Waite, R. A. Oakley and R. C. Althouse.

DR. GRINNELL JONES, of the division of chemistry, Harvard University, has resigned his position as consulting chemist to the U. S. Tariff Commission.

THE past and present pupils of Dr. Garcia Valenzuela, professor of physiological chemistry at the university of Santiago, Chile, gathered on the occasion of his retirement from the chair he has held for thirty years to pay him honor and recall his contributions to chemistry and histology.

A VOLUME of his collected works is to be presented to Professor E. Tanzi, Florence, on his seventieth birthday, during the seventh congress of the Italian Society of Neurology at Turin in April.

A TESTIMONIAL dinner was given March 23 in honor of Dr. Francis Edward Stewart by the faculty of the Philadelphia College of Pharmacy and Science.

AT Princeton University, leaves of absence for the first term of the next academic year have been granted to Professors H. L. Cooke and Karl Taylor Compton, of the department of physics. Professor

E. Gille, assistant professor of mathematics, has been given leave for the whole of the next academic year.

BERNAL R. WEIMER, professor of biology at Bethany College, Bethany, W. Va., has been granted a leave of absence for the coming academic year to continue graduate work at the University of Chicago.

THE Japanese Society of Cancer Research has recently appointed three research members under its special research fund: K. Yamagiwa, emeritus professor in the Tokyo Imperial University; T. Ogata, professor of pathology in the Tokyo Imperial University, and W. Nakahara, associate pathologist in the Government Institute for Infectious Diseases.

A. RODGER, president of the Forest Research Institute and College at Dehra Dun, India, is to succeed Sir Peter Clutterbuck as inspector-general of forests and will combine his new duties with the presidential duties already in his charge. This indicates a step in reorganization which has long been desired by the chiefs of the forest department.

ROBERT T. BOOTH was succeeded on April 1 by Richard H. Goddard as observer-in-charge of the Huancayo Magnetic Observatory (Peru) of the Carnegie Institution of Washington. Mr. Booth will return to Washington across South America *via* the Amazon as a member of the special expedition of Messrs. Dahl and Ramberg.

HUGH R. STILES has resigned his position as research assistant in agricultural bacteriology at the University of Wisconsin to accept a position in the bacteriological research division of the Commercial Solvents Corporation, Terre Haute, Ind.

C. C. MERRILL, executive secretary of the Federal Power Commission, has been designated to represent the United States at the world power conference in Basle, Switzerland, August 31 to September 12.

CAPTAIN D. L. VAN DINE, director for Cuba of the Tropical Plant Research Foundation, recently visited the Sugar-Cane Insect Laboratory of the U. S. Bureau of Entomology, at New Orleans, La., for conference concerning future projects.

DR. FRANK D. KERN, of the Pennsylvania State College, and R. A. Toro, of the Insular Experiment Station of Porto Rico, spent the month of March in botanical explorations in Santo Domingo. The trip was made under the auspices of the University of Porto Rico and the Insular Department of Agriculture. Especial attention was given to the study and collection of parasitic fungi. Dr. Kern is spending the academic year at the Agricultural College of the University of Porto Rico.

PROFESSOR E. C. FRANKLIN, of Stanford University, has accepted an invitation to give a course of thirty lectures on "The Ammonia System of Compounds" in the forthcoming summer session of Western Reserve University from June 21 to July 30.

DR. A. A. WARTHIN, professor of pathology at the University of Michigan, gave an address before the alumni at Phoenix, Arizona, on March 25. Professor Warthin stopped at Phoenix on his return trip from Pasadena, California, where he went to deliver the dedicatory address at the Stanley Black Memorial Building.

DR. F. S. HAMMETT, of the Wistar Institute of Philadelphia, gave a talk on "The Rôle of the Thyroid Apparatus in the Growth of the Reproductive System," before the Journal Club of the Station for Experimental Research, Cold Spring Harbor, New York, on April 15.

S. T. WILLIAM, chief engineer of the Victor Talking Machine Co., will give a lecture before the Franklin Institute on April 29, on "The Recent Development in the Production of Sound."

SIR ARTHUR NEWSHOLME, of England, will give the Cutler lectures in preventive medicine at the Harvard Medical School on April 26 and 27 at 5 P. M. The subjects will be "The Present Position of the Tuberculosis Problem" and "Remaining Problems in Maternity and Child Welfare."

PROFESSOR HARDOLPH WASTENEYS, of the department of biochemistry at the University of Toronto, delivered an address to the Royal Canadian Institute on the subject "What We Eat, and How We Digest It."

DR. R. J. TILLYARD, chief of the biological department of Cawthron Institute, Nelson, New Zealand, delivered an illustrated lecture on "Fossil Insects," before the Science Club at Kansas State Agricultural College on April 7.

DR. ALBERT B. LYONS, for many years chemist for Belson, Baker and Co., Detroit, and formerly a member of the committee of revision of the "U. S. Pharmacopoeia," died on April 13 in his eighty-sixth year.

DR. LUCIUS W. HOTCHKISS, formerly professor of clinical surgery at the Columbia University College of Physicians and Surgeons, died on March 12, aged sixty-six years.

SIR JOHN BURCHMORE HARRISON, for thirty-seven years head of the department of science and agriculture of the British Colonial Service, Georgetown, Demerara, British Guiana, died on February 8.

DR. JOHANNES GAD, emeritus professor of physiology at the German University of Prague, has died, aged eighty-four years. In 1887 he founded, with

Exner, the *Centralblatt für Physiologie,* and in 1893 he aided in organizing the work in experimental physiology at the Western Reserve University, Cleveland.

SIGMA XI fellowships are available for 1926–27 to men and women for research work in all fields of science, pure and applied. Applications, which should be made before May 15 to Dean Edward Ellery, Union College, Schenectady, N. Y., should be accompanied by a statement of the problem to be studied, the place where the work is to be done, the amount of money needed, the applicant's educational and research experience, degrees received, reprints of published articles (or titles and periodicals in which they were published) and letters from at least two individuals competent to express an opinion on the importance of the problem in the particular field. Awards will be made by June 1, and will be available after August 1, 1926, and up to August 1, 1927.

THE annual dinner of the Kappa chapter of Sigma Xi was held in the men's Faculty Club, of Columbia University, on April 22. It was preceded by the initiation at six o'clock. Professor H. W. Stunkard, of New York University, and Professors Cassius J. Keyser, Frederic S. Lee and Michael I. Pupin, of Columbia University, were among the speakers.

THE South Dakota Academy of Science will hold its tenth annual meeting at Mitchell, South Dakota, on April 30 and May 1, under the presidency of J. Gladden Hutten. The other officers are Dr. J. P. Connolly, *vice-president;* A. P. Larrabee, *second vice-president,* and A. L. Hains, *secretary-treasurer.*

A JOINT meeting of the American Section of the Society of Chemical Industry, American Chemical Society, American Electrochemical Society and the Société de Chimie Industrielle was held on April 16 in Rumford Hall of the Chemists' Club in New York at 8:15 P. M. The following papers were presented: "Catalytic Oxidation of Organic Compounds in the Vapor Phase," Charles R. Downs; "The Significance of Catalysis in the Study of Chemical Reactions," K. George Falk.

THE fourth National Colloid Symposium will be held at Cambridge, Mass., June 23, 24 and 25. The program thus far announced is as follows: J. W. McBain, "A Survey of the Main Principles of Colloid Science"; W. D. Bancroft, "The Water Equilibrium"; F. E. Bartell, "The Function of Carbon Membranes in Osmosis and Ultrafiltration"; T. R. Briggs, "The De-Inking of Paper"; F. L. Browne, "The Place of Adhesion in the Gluing of Wood"; E. F. Burton, "The Holmholtz Double Layers as related to Ions and Charged Particles"; G. L. Clark, "X-rays and Colloids"; W. P. Davey, "Making and Breaking of Emulsions"; K. H. Gustavson, "Effect of Pre-treatment with Various Salts upon the Combination of Collagen with Tannin and Chromic Oxide"; E. O. Kraemer, "Studies on Gelatine"; W. K. Lewis, "Mass Action Effects in the Interaction of Gelatine and Acid"; I. F. McClendon, "Colloid Properties of the Surface of the Living Cell"; B. Mead, "Emulsification: A Study of Oil Soluble Emulsifying Agents"; S. E. Sheppard, "Deflocculation and Flocculation of Silver Halides"; Miss G. Spence, "Pectin Jellies"; A. J. Stamm, "Electroendosmose through Wooden Membranes"; H. S. Taylor, "The Colloid Particles as revealed by Catalytic Studies"; C. Torzaghi, "The Mechanism of Adsorption and the Swelling of Gels"; A. W. Thomas, "The Adsorption of Ferric Oxide Hydrosol by Charcoal"; H. B. Weiser, "Ionic Antagonism in Colloid Systems"; G. S. Whitby, "Organophile Colloids."

IN accordance with a request made by the United States Bureau of Soils and approved by the director of the budget, there has been included in the bureau's appropriation for the fiscal year 1927 an item of $185,000 which will enable the Secretary of Agriculture to continue the research work of the Fixed Nitrogen Research Laboratory under the bureau.

THE gift of $100,000 to aid cancer research conducted at the University of Chicago by Miss Maude Slye has been announced. The fund is a bequest of the late E. F. Holmes, whose daughter, Harriet F. Holmes, has been associated with Miss Slye in her work.

THE validity of a provision in the will of Mrs. Elizabeth B. Frasch, creating a $1,000,000 trust fund, to be known as the Herman Frasch Foundation for Chemical Research, has been sustained by the courts. In her will Mrs. Frasch directed the trustees named by her to pay the income from the fund to one or more incorporated institutions in the United States selected by the trustee after consulting with the American Chemical Society, upon condition that the institutions agree that the money be devoted to research in the field of agricultural chemistry, with the object of attaining results which would be of practical benefit to the agricultural development of the United States.

IN memory of Dr. Ognibene, his widow has recently given to the University of Modena 80,000 liras, with which to establish two Ognibene prizes open to students of the college of medicine, according to the *Journal* of the American Medical Association. To the same university, there has recently been presented about 1,000,000 liras, the gift of Dr. Araoz, director general of the public health service in Argentina and professor at the faculty of medicine in Buenos Aires. The money is to be used to found a university institute to promote tuberculosis prophylaxis.

UNIVERSITY AND EDUCATIONAL NOTES

WASHINGTON UNIVERSITY, St. Louis, will receive $548,270 by the terms of the will of the late Ellis Wainwright.

THE late Professor Albion Small, who was professor of sociology at the University of Chicago, has left $25,000 to the university.

AT Harvard University, Arthur E. Wells, consulting engineer of New York, has been appointed professor of metallurgy. Three members of the faculty have been promoted to full professorships. Assistant Professor Edward S. King becomes Phillips professor of astronomy; George S. Forbes, professor of chemistry; Emory L. Chaffee, professor of physics for three years, and Professor Percy W. Bridgman, Hollis professor of mathematics and natural philosophy.

DR. V. A. C. HENMON, director of the school of education at the University of Wisconsin, has accepted an appointment as professor of educational psychology at Yale University.

DR. JOHN T. BUCHHOLZ, of the University of Arkansas, has been appointed head of the department of botany at the University of Texas.

FRANK C. WHITMORE, professor of organic chemistry at Northwestern University, has been named head of the department, succeeding W. Lee Lewis, who will continue as director of research of the Institute of American Meat Packers. Dr. Lewis will also serve as professor of organic research at Northwestern University.

PROFESSOR J. H. HILDEBRAND has resigned from the position of dean of men in the University of California, which he has held during the past three years, in order to devote his entire time to his work as professor of chemistry.

THOMAS DE VRIES, of the University of Illinois, has been appointed head of the department of physical chemistry at Purdue University. Mr. De Vries takes the place of Professor F. O. Anderegg, who is going to the Mellon Institute, Pittsburgh, Pa.

DR. IRVINE MCQUARRIE, of the department of pediatrics in the Henry Ford Hospital, has been appointed assistant professor of pediatrics at the University of Rochester.

DR. MORTON PRINCE has been appointed associate professor of abnormal and dynamic psychology at Harvard University.

DR. M. C. FOSTER, of Yale University, has been appointed assistant professor of mathematics at Williams College.

AT Amherst College, Warren K. Green has been promoted to professor of astronomy and director of the observatory and Atherton H. Sprague to professor of mathematics.

DISCUSSION AND CORRESPONDENCE

MAPS FOR THE INTERNATIONAL GEOLOGICAL CONGRESS AT MADRID

IT is exceedingly difficult to procure foreign geological maps in this country nor do we appear to have any well-recognized authorities, commercial or otherwise, to whom we can turn for adequate and thorough advice regarding recent editions of European maps. Geologists who are expecting to attend the International Geological Congress may hope to receive all the maps necessary for the excursions when they reach Madrid. However, many geologists will probably wish to make excursions other than those provided by the congress. Since 1922 I have tried to keep in touch with the publications of foreign maps as a necessary part of the equipment for the graduate course in stratigraphy at Princeton University, and can recommend the following maps for Central Europe. It is not possible to buy these maps in this country, and for those who wish to procure foreign maps I believe there is no better way than to write to Edward Stanford, Ltd., 14 Long Acre, London. The telegraph address is Estanfomap, Rand, London. A communication to their Mr. Berg, who is in charge of the map department, will bring prompt and efficient service. I know of no other "house" which is so satisfactory.

It is exceedingly difficult to get good maps of Spain. There is one of Spain and Portugal on a scale of 1:400,000 in sixty-four sheets with four sheets out of print. There is another handy, pocket folder type, published in 1919 on a scale of 1:1,500,000. This is also a very good map, but unfortunately exceedingly scarce, and I do not believe it can be bought in this country. For Italy, the latest general map, so far as I can determine, was published in 1889 in two sheets on a scale of 1:1,000,000. The latest edition of the French geological map, in four sheets, was published in 1905 on a scale of 1:1,000,000. This is an excellent map. There are several new maps of the different districts in the Alps, of which the "Tektonische Karte," by Rudolf Staub, 1923, should be mentioned. This map is in one sheet on a scale of 1:1,000,000. For England, Scotland and Ireland, Geikes's "folder," geological maps (new edition) still remain the standard. Mention should be made of the Assynt District "special map" (1923), which is especially desirable for those intending to visit the North West Highlands of Scotland. The last map of Cyprus (single sheet) appears to have been published in 1905 in English. There is a very recent but "sketchy" map of Egypt on the scale of 1:2,000,000. Very good general maps

have also been very recently published on Norway, Sweden, Czechoslovakia, Hungary, Morocco, Caucasus and Belgium.

Richard M. Field

Princeton University

SCIENCE SERVICE AND THE LOCATION OF EARTHQUAKE EPICENTERS

Recognizing the great popular and scientific interest in the subject of earthquakes and the desirability of providing a means by which the exact epicenter of at least moderately severe earthquakes could be reported promptly to the press and to seismologists, Science Service has provided and had in operation for about a year a system of cooperative earthquake reporting. In March, 1925, a scheme of cooperation with the Division of Terrestrial Magnetism and Seismology of the U. S. Coast and Geodetic Survey was effected, and in January, 1926, this was extended to include the Jesuit Seismological Association, which numbers in its membership the numerous seismograph stations of the Jesuit colleges.

The first regular reports of earthquakes were made by the Rev. Francis A. Tondorf, S.J., in charge of the Georgetown University Seismograph Station, in 1913, through the Associated Press. Father Tondorf has continued this service to the present, and in recent years other individual stations have also announced their results. Such reports include the time, an estimate of the distance and of the directions, but do not give the position of the epicenter, for this can not be determined with accuracy from the reports of a single observatory.

The new work of Science Service is not intended to supersede this valuable work, but to supplement it. The method is as follows:

As soon as a quake of at least moderate severity is recorded at any of the eighteen stations cooperating, the seismologist in charge read their records and telegraph the data to Science Service in Washington. To facilitate this transmission a special code has been devised, a modification of the Gerrish Astronomical Code used by the Harvard College Observatory in reporting new discoveries. The earthquake code permits all the necessary data to be transmitted in eight code words, of five two-letter syllables each, each syllable representing a digit. These telegrams are decoded and the data transmitted to the Coast and Geodetic Survey, where the work is in charge of Commander N. H. Heck, chief of the division. The same data are also telegraphed to the Rev. James B. Macelwane, S.J., in charge of the Jesuit Seismological Association's central station at St. Louis.

Determinations of the epicenter are made by both the Coast and Geodetic Survey and the Jesuit Seismological Association and transmitted immediately to Science Service. Announcement of the epicenter is then made by Science Service through its subscribing newspapers by telegraph and mail, reaching a total of about one hundred papers in all parts of the country.

The stations now cooperating in this project are as follows: Those of the Coast and Geodetic Survey of Tucson, Arizona; Cheltenham, Md.; Sitka, Alaska; Honolulu, T. H., and San Juan, P. R.; stations affiliated with the Jesuit Seismological Association at Georgetown University, Washington; Fordham University, New York; Spring Hill College, Mobile, Ala.; Loyola University, New Orleans; St. Louis University, St. Louis, Mo.; Regis College, Denver, Col.; University of Santa Clara, Santa Clara, Calif.; and Gonzaga University, Spokane, Wash.; and the stations at Harvard University, Cambridge, Mass.; Yale University, New Haven, Conn.; the U. S. Weather Bureau, Chicago, Ill.; the Dominion Observatory, Ottawa, Canada, and the private station of Mr. J. J. Shaw, at West Bromwich, England.

This scheme first functioned with the Montana earthquake of June 27, 1925, and since then twenty-two epicenters have been located, all within a few hours after the records were obtained, and in good agreement with later determinations made by detailed study of the seismograms. The details of the operation of the service are under the supervision of Mr. James Stokley, of the Science Service staff.

Arrangements for a further extension of the service are now being completed, in order to provide data from a group of stations in southern latitudes.

Watson Davis

Science Service,
Washington, D. C.

THE AUTOMOBILE AND WILD LIFE

During the past spring and summer some observations of dead animals which had obviously been killed by automobiles were made along highways in Illinois. These observations were all made in the central part of Illinois and on concrete highways where auto traffic was very heavy.

Counts of dead animals were made along a total of 299 miles of highway during April, May, June, July and August. The total number of animals noted on the highways were as follows:

Birds[1]	24
Brown Thrasher	1
Cats	4
Chickens	17
Flickers	2
Gophers	29
Mourning Dove	1
Owl	1
Rabbits	22

[1] Birds include those so badly mutilated that they could not be positively identified.

Rats	2
Red-headed Woodpecker	20
Robin	1
Skunk	1
Snakes	10
English Sparrows	84
Squirrels (Gray)	2
Toads	3
Animals[2]	3
Total	230

The observations on the number of animals killed were all made on trips of from eight to fifty-four miles, in most cases, starting from Champaign, Illinois. The total number of 230 dead animals probably represents the animals killed within three days of the time the examinations were made. In one case, a gopher was killed by an automobile immediately in front of the one in which the observer was riding, and on returning over the same route about eight hours later, the body of the gopher was found flattened out and nearly dry, having been run over by a large number of automobiles in the interval since it was killed. It is doubtful if the body of the animal would have remained on the highway another day. In another case, the body of a sparrow disappeared from the highway on the third day after it was killed.

On the cement highways of Illinois, the automobile traffic is usually very heavy, and through the country an average speed of from twenty-five to thirty-five miles an hour is maintained by nearly all cars. Animals killed on such highways are repeatedly run over, and all moisture is rapidly crushed out of the bodies, and in a short time they are blown off by the wind, or by the air from passing automobiles.

There are several things of special significance in connection with the dead animals noted in these observations. If the observations are taken by months, and considering only those animals which occurred in largest numbers, we find that during April observations on fifty-four miles of highway showed:

Sparrows	3
Rabbits	4
Snakes	5
Gophers	10
Red-headed Woodpeckers	0

On the sixty-eight miles of highway observed in May were found:

Sparrows	7
Rabbits	5
Snake	1
Gophers	8
Red-headed Woodpeckers	0

[2] Animals in the same condition as birds.

On the seventy-four miles of highway observed in June were found:

Sparrows	10
Rabbits	6
Snakes	3
Gophers	6
Red-headed Woodpeckers	5

On the sixty-four miles of highway observed in July were found:

Sparrows	30
Rabbits	7
Snake	1
Gophers	4
Red-headed Woodpeckers	14

On the thirty-nine miles of highway observed in August were found:

Sparrows	34
Rabbits	0
Gopher	1
Red-headed Woodpeckers	3

Apparently the sparrows are killed in the greatest numbers during the time that the young are most abundant. It is also possible that the larger kill of sparrows during July and August was due, at least in part, to the fact that during this period small grain was being threshed generally throughout the farming districts and hauled in wagons over the concrete highway to elevators. Small amounts of grain were scattered from the wagons over the highways, and it is probable that many of the sparrows killed were surprised while feeding upon this grain. It would seem that the greatest number of snakes are killed during the spring months, when they are just coming out of hibernation and are more or less sluggish. The number of rabbits remain fairly constant throughout the summer, but the number of gophers decreased slightly after the spring months. It is also apparent that the red-headed woodpeckers were killed in greatest numbers during midsummer, and as many of the birds observed were young it seems likely that these are killed in greatest numbers shortly after the time when they leave the nest. The small numbers of chickens killed was rather surprising and it is probable that a greater effort is being made to keep them off the highways.

W. P. FLINT

ILLINOIS NATURAL HISTORY SURVEY,
URBANA, ILLINOIS

ON EINSTEIN'S THEORY OF RELATIVITY

PROFESSOR ALBERT EINSTEIN and other experts have repeatedly stated that, although the theory of rela-

tivity was originally derived from Michelson and Morley's experiment, its very *"experimentum crucis,"* its *decisive experiment,* is based on Fresnel-Fizeau's effect. Undoubtedly in the certainty of result this laboratory experiment very much surpasses Michelson and Morley's so-called ether drift experiment. This depends on the velocity of the earth in an hypothetical way; that velocity is a circumstance outside the laboratory, quite beyond our control, not changeable, not reversible. In Fizeau's experiment, on the contrary, the main cause of the effect and all details are well controllable, exactly determinable and they may be changed at will.

Now then, this *"experimentum crucis"* was not even mentioned in recent discussions! Is this experiment, so emphatically pointed out as decisive, now quite worthless? What remains then of the alleged steel logic in Einstein's theory?

My paper[1] shows that the usual interpretation of Fizeau's effect, in the sense meant by Fresnel's dragging coefficient, derives from a subtle error. This I explained more in detail and confirmed in my book "Nouvelles Vues Faraday-Maxwelliennes" with "Supplément. Sur la Propagation de la Lumière" (Gauthier-Villars et Cie, Paris, 1924). My paper "On Kinematics,"[2] treats the same fundamental question in another way. According to my result the true sense of Fizeau's effect is quite different from what we formerly admitted, it being the reserve. However, this in no way lessens the certitude and importance of the experimental result.

Professor Dayton C. Miller claims a result for his repetition of Michelson and Morley's experiment, which at the most is 30 per cent. of the calculated effect. The discussion has shown that that result is questionable on account of several grounds. In this respect I quite agree with Professor Einstein. That is to say, Professor Miller certainly observed an effect of the given magnitude, but the question remains: is it due to the alleged ether drift? There is no uncertainty of this kind in Fizeau's experiment. The recent excellent experiments by Professor P. Zeeman, Amsterdam University, fully confirm the formula for Fizeau's effect established according to my views, without introducing any hypothesis. In fact, Zeeman's experiments, which are universally acknowledged to be correct, confirm my formula to practically 100 per cent.

Zeeman's result is the decisive disproof of Einstein's theory.

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[1] *Comptes Rendus,* CLXXV, p. 574 (1922).
[2] *Philosophical Magazine,* XLIX, p. 579, March, 1925.

IODINE IN THYROID DEFICIENCY

Perhaps in addition to Miss Simpson's statements (Science, February 5, 1926) regarding the use of iodine in thyroid troubles, certain remarks by Boussingault in his "Viajes Científicos a los Andes Ecuatoriales" (Spanish translation by Acosta, I have not the original French text) may be of interest. In one "Memoria" he definitely states (1825) that "till now, iodine is the only specific known for goiter." Elsewhere he continues, regarding certain mineral springs in Colombia, "In the province of Antioquia no other salt is used, save that from these peculiar springs, whose waters I have analyzed and convinced myself that, though the composition of their salts is variable, there is in all an appreciable amount of iodine. Hence the reason that there is no goiter in Antioquia: each inhabitant takes every day a dose of iodine with the salt he consumes." Again: "It is a singular fact that for more than a century these waters have been recognized as a sure specific for goiter."

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SCIENTIFIC BOOKS

The Biology of Fishes. By Henry M. Kyle, M.A., D.Sc., Sidgwick & Jackson, Ltd., London.

Kyle's "Biology of Fishes" is a very complete and useful work, covering almost every phase of fish life and generally in touch with the latest investigations in anatomy and physiology. The author recognizes fully that the fishes constitute an expanding and diverging as well as very ancient type. The reptiles, birds and mammals are, so far as their origins are concerned, all of them divergent groups which have arisen from the fishes, and in some regards no more different from their primitive ancestors than these differ from one another.

One does not willingly criticize so excellent a book, but a few minor points may be noted. Apparently common heredities are not adequately considered as compared with likenesses due to surroundings. The mass of fishes would appear to form a pool from which individual structures and customs can be drawn out for examination without much reference to heredity, although the latter is the basis of rational classification. The distinctions between homologies and analogies are not always clear in the author's statements and structures are often assigned to secondary cause of recent date, when their real origin may be far older and even beyond the reach of investigation. The true sources of most structures must be sought in heredity rather than the immediate response to environment on the part of a living species.

Dr. Kyle has a curious way of personifying the individual fish, by treating as voluntary actions which, so far as we know, are wholly automatic or instinctive. "The trout itself, like other fresh water fishes, has to keep a wary eye on the pike, the otter and other enemies from above. No wonder he is clever and prefers to seek his food by night or when the water is perturbed." This is apparently a vivid way of saying that the trout is alert and timorous, not that each individual thinks the matter over in deciding when to feed.

Again, "Gulls seem to know that fishes can not hear, and keep up a ceaseless chattering and screaming as they fill themselves with the rich booty." As we watch the fish in its daily operations, it is not easy to refrain from reading our own thoughts and our own springs of action into those active but largely instinct-controlled creatures.

The effort to trace a mechanical cause for each special structure sometimes carries our author far into speculation. Thus—"in other species, the feeble development or absence of teeth indicates a disturbance of the growing tissues, and this has resulted in the formation of a long snout, as in the Sail-fish and the Sword-fish. In other cases the disturbance has led to the temporary closure of the mouth (as in the Pipe-fishes and Flat-fishes) and this to a great elongation of the body with increase in number of the vertebrae, loss of the ventral fins and even of the caudal."

The conception of "mutations" or sudden changes in certain characters, leaping outside of or beyond heredity, is accepted by Dr. Kyle, and I think unduly extended. For example, he suggests that the primitive fish was "possibly a mutation from some larval form of lower degree at the beginning."

The earlier and less specialized fishes have an air duct connecting the air bladder with the gullet. Perhaps one third of the known species lose this duct at maturity, such being in general the more recent and more specialized forms, few of them apparently dating before the Tertiary. The loss of this duct, our author ascribes to a "mutation." It is more or less concurrent with numerous other changes, which appear by degrees, the forward movement of the ventral fins, the reduction of the number of their rays, the specialization of the vertebrae, with usually their reduction in number, the presence of fin spines, the rough (ctenoid) edges to the scales, and a variety of other characters, in addition to this "mutation."

He says:

Mutations do not break through any law of nature, but they make things difficult for the natural selectionist. Organs like the fins and open air bladder duct, which are of proven utility, should not change or disappear. Yet a very large number of the Teleosts have come from just these two mutations.

The fact is that about one third of all fishes have progressively lost certain primitive traits which have been replaced by other characters, and we can only guess as to how it was done. Doubtless our author is right in not ascribing such changes to selection alone, for, as he says, "the elimination of weaklings and the unfit is not a true cause of the formation of a species." It is a negative process, trimming up or keeping in form the mass of the species itself, holding it up, as it were, to its highest efficiency. Those individuals who run the gauntlet of life, whatever its nature, leave descendants endowed with like potentialities.

How, in the lost history of the past, one species gives place to another we can only speculate. It is true, however, that every species, natural or artificial, is modified by some sort of selection, no individual escaping from such influence. In every case we know of, a given species is set off from its relatives, by some sort of isolation, with segregation. Heredity and variation represent inherent tendencies. The waves of life are checked or turned by the external obstacles encountered. No species can cross a barrier without finding new conditions, new climate, new foods, new enemies. In time every barrier surmountable leaves its impress on the group on either side of it. Every student of species, men, animals, plants, languages, has recognized this fact. No sound conception of evolution can leave geography out. Some day, evolutionists will again come back to the dictum of the great master of zoogeography, Moritz Wagner, "Ohne Isolirung keine Arten" (without isolation, no species).

The word mutation is used vaguely by many authors. Sudden changes of the minor order occur frequently and may sometimes give rise to a hereditary series. but this occurs only when separated, by natural or by artificial means, from breeding with the mass. Mutations, as distinguished from mere freaks, are common enough in nature but perhaps in no conceivable case do they mark the origin of a species. These variants are readily cultivated or bred, but they disappear whenever thrown on their own resources. This may be due to interbreeding with the selected, outnumbering and prepotent mass of the species; sometimes from inherent weakness or other cause traceable in the individual case. So far from "mutations" in the de Vriesian sense being the method of the Origin of Species, no actual student of species in the field can accept a theory so divergent from actual facts.

Mutation, in Dr. Kyle's scheme, is not very clearly defined, but the process to which he refers is appar-

ently something not being instantaneous but taking long ages to accomplish and not concerned with any single character of a single species. If not defined in some such fashion, it has no reality. Mutation, as viewed by de Vries, is a sudden change within a species, which gives rise to a new one, closely akin, but with a break in heredity, the new species persisting, and at times replacing the old *within the same environment*. If the new and old are competing, selection may decide.

The conception of the origin of species by mutation, now accepted by many authors, especially botanists, rests on the slightest of foundations. In most groups are found "geminate" or twin species, closely related. Scarcely ever are these twins found in the same region, scarcely ever far apart, but always separated by some barrier, land, water, climate, food, space or enemies. Such separation saves variants, however originated, from being lost through interbreeding with the mass. Forms separated by barriers are subject to new selections; they have new gauntlets to run. They are not products of selection in competition with the old stock, for in no case as far as I know are their characters of survival value, as was supposed by Darwin. Nor is there any adequate evidence for presuming species to appear suddenly, "full-fledged," from germ cells of an old species. The belief in this process is, I think, one of the myths of science.

In Dr. Kyle's work, so complete and suggestive in most regards, I find no important account of the origins and relations of orders and families nor of the origins of species. The lower differences come first in nature and the higher problems are largely beyond our reach, in the realm of speculation. In the history of science guesses, however brilliant, have rarely proved true.

Taxonomy, with Cuvier, is primarily the systematic way of stating the known facts of comparative anatomy. Now that we recognize that comparative anatomy is itself a statement of the trend of evolution, classification has naturally become the expression of evolution. A complete biology of fishes should elucidate this.

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SPECIAL ARTICLES

ON THE EQUILIBRIUM BETWEEN THE ENAMEL OF THE TEETH AND THE SALIVA

IN studying the equilibrium between sea water and calcite[1] it was found that crystals of calcite had to be very clean in order to get an equilibrium by shaking with sea water in a thermostat in any practical length of time. If clean crystals of calcite (or aragonite) were shaken with sea water, an equilibrium was established in a few hours, but if ground-up shell or coral or limestone mud was shaken with sea water, an equilibrium was not even approached in three or four days. In studying the equilibrium of enamel of the teeth and the saliva at different pH values, it was thought that this factor complicated the results. Therefore studies on crystals of fluorapatite [CaF Ca_4 $(PO_4)_3$] were made, using an artificial saliva containing no proteins or capillary active substances that would tend to deposit on the surface of the crystals.[2] At pH between 5.5 and 6.5, the apatite was practically at equilibrium with this artificial saliva containing the same quantity of calcium phosphate as in normal saliva. From this data and also from the fact that impure masses of calcium phosphate deposit on the teeth, it was concluded that at a pH between 6 and 7 the enamel of the teeth should not dissolve in the saliva.

It therefore seemed desirable to find a method of cleaning the surface of the enamel of the teeth so that an equilibrium with the saliva could be established. In this case, theoretically, the enamel should grow with increase in pH and dissolve with decrease in pH.

Since there is a general impression that gritty substances used on the teeth will wear away the enamel, the following observation was made using calcite crystals newly formed and therefore clean on their surfaces and sharp at their angles, to see whether such an abrasive would wear away the teeth. Calcite crystals, which were rhombohedral and of large enough size to feel gritty, did not perceptibly wear the enamel in a total of sixty hours polishing with the dry powder and dry brushes. Only one experiment was performed. During the five years from the age of thirty-five to forty, the teeth were brushed two minutes a day with a dry brush, and during this time hard deposits collected on the teeth, which were removed by the dentist. These deposits seem to collect on rough places. During the next five years, from the age of forty to forty-five, the teeth were polished for two minutes daily with the dry calcite crystals on a dry brush. The roughness gradually disappeared and no hard deposits occurred on exposed surfaces of teeth during this period.

Calcite crystals were formed by nearly filling a one hundred liter jar with water and allowing molecular solutions of sodium carbonate and calcium chloride to run in on opposite sides of the jar at the rate of

[1] Proc. Nat. Acad. Sci., 3: 692, 1917.

[2] *Jour. Dent. Research*, 3: 50, 1921.

½ cc per second, while the water was vigorously stirred by a powerful stirrer placed eccentrically. The crystals were observed microscopically and the process continued until some spherules appeared when stirring was stopped, crystals collected, the jar was emptied and the process repeated.

Although these observations do not solve the problem of dental decay, they are offered in the present form because a solution of that problem does not seem immediately forthcoming, and yet it seems to be very important, owing to the fact that the enamel of the teeth is subject to the most frequent lesions which have not, so far, been repaired by regeneration of the tissue.

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FLUORIDES VS. FLUOSILICATES AS INSECTICIDES

MARCOVITCH[1] reported that sodium fluosilicate undiluted is effective against the cotton boll weevil (*Anthonomus grandis* Boh.), and when mixed with nine parts by volume of hydrated lime is effective against the Mexican bean beetle (*Epilachna corrupta* Muls.), the Colorado potato beetle, the potato flea beetle, the bean leaf beetle and the tobacco hornworm.

There is nothing new in the use of sodium fluosilicate as an insecticide. Its use for that purpose was described nearly thirty years ago by Higbee (English Patent No. 8236, May 23, 1896). More recently Wille[2] has reported tests with sodium fluosilicate against roaches, and Cobenzl[3] mentions it as a common ingredient of rat and insect poisons.

During the past year entomologists have shown much interest in sodium fluosilicate (also known as silicofluoride) and have made many tests with it, particularly against the Mexican bean beetle. The results obtained have varied greatly, however, and foliage injury has been produced by its use. These variable results are not surprising in view of the fact that commercial grades of sodium fluosilicate contain varying quantities of the fluosilicate of sodium and fluoride of sodium, and often carbonate of sodium. The occurrence of sodium carbonate in commercial sodium fluosilicate is of particular significance because an alkali in solution in water quantitatively decomposes a fluosilicate into a fluoride. In fact, one of the commercial processes of manufacturing sodium fluoride[4] is based on this reaction, which is represented by the following equation:

$$Na_2SiF_6 + 2Na_2CO_3 + H_2O = 6NaF + H_2SiO_3 + 2CO_2$$

Sodium fluosilicate may not only be partially decomposed into a fluoride, owing to the presence of sodium carbonate, but it may be broken down by alkaline water used in spraying. Most waters are more or less "hard," because of the presence of soluble calcium and magnesium salts. Sodium fluosilicate would react when added to such a water to form calcium and magnesium fluosilicates, which in turn would break down partially into calcium and magnesium fluorides. When mixed with a large excess of hydrated lime, sodium fluosilicate, in the presence of water, would be converted into calcium fluosilicate, and this in turn into calcium fluoride. When a mixture of sodium fluosilicate and an excess of hydrated lime is applied as a dust, as was done by Marcovitch, this conversion would not be immediate but would proceed as the mixture became moistened by rain, dew or even the water vapor in the air.

Power and Chesnut[5] have shown that ammonia and trimethylamine are present in emanations from the living cotton plant. Smith[6] has shown that the dew on the leaves of the cotton plant has an alkaline reaction to litmus, due in part at least to the presence of calcium and magnesium carbonates and bicarbonates and potassium carbonate. All these compounds would favor the decomposition of a soluble fluosilicate into a fluoride.

As used under practical conditions in the field, therefore, the sodium fluosilicate in a commercial grade of the material, before coming into contact with the insects, might be largely if not entirely converted into a fluoride, owing to the action of (1) sodium carbonate originally present, (2) alkaline or "hard" spray water if sprayed or hydrated lime if dusted, (3) alkaline emanations or exudations from the plants to which it is applied. Even pure sodium fluosilicate in solution in pure water is hydrolyzed to some extent into sodium fluoride and silicon fluoride.[7]

When sodium fluosilicate is mixed with lime preparatory to its application as an insecticide an interesting cycle is completed. By the action of sulfuric acid on fluorspar (calcium fluoride) the chemical manufacturer obtains hydrofluoric acid. This added to sand forms "sand" acid (hydrofluosilicic acid). By the interaction of this and soda ash (sodium carbonate) sodium fluosilicate is formed. When the entomologist adds hydrated lime to this compound the

[1] *Ind. Eng. Chem.*, 16, 1249, 1924; SCIENCE, 61, 22, 1925; *J. Econ. Entomology*, 18, 122, 1925.

[2] Biologie und Bekämpfung der deutschen Schabe, *Phyllodromia germanica* L., Monographien zur angewandten Entomologie No. 5, Beiheft 1 zu Band 7, Ztschr. angew. Ent., Berlin, 1920, p. 126.

[3] Chem. Ztg., 45, 1116, 1921.

[4] Bishop, U. S. Patent No. 1,382,165, June 21, 1921.

[5] *J. Am. Chem. Soc.*, 47, 1751, 1925.

[6] *J. Agr. Research*, 26, 191, 1923; SCIENCE, 61, 572, 1925.

[7] Hudleston and Bassett, *J. Chem. Soc.*, 119, 403, 1921.

original calcium fluoride is regenerated. Why not use calcium fluoride (or some other slightly soluble fluoride) in the first place?

Three years ago I discovered that certain fluorides whose solubility in water is less than that of barium fluoride are effective stomach poisons to leaf-eating insects and are so insoluble in water that they do not injure even such delicate foliage as that of the peach tree. Garman, of the Connecticut Agricultural Experiment Station, who collaborated in this investigation, found, for example, that strontium fluoride has a toxicity to the tent caterpillar (*Malacasoma americana* Fab.) comparable to that of lead arsenate.

The solubility in water of the more common inorganic fluorides is as follows:[8]

Fluoride	Formula	Grams soluble in 1 liter water
Ammonium fluoride	NH_4F	Very soluble
Potassium fluoride	KF	923.0
Sodium fluoride	NaF	40.0
Lithium fluoride	LiF	2.7
Barium fluoride	BaF_2	1.63
Strontium fluoride	SrF_2	0.117
Magnesium fluoride	MgF_2	0.087
Calcium fluoride	CaF_2	0.016

The results of the tests with the insoluble fluorides as insecticides have been very encouraging and will be reported in detail in due time. Meanwhile, it is suggested that the insecticidal action of the less soluble fluorides be utilized rather than that of the fluosilicates, as it is believed that not only will more uniform insecticidal action be obtained, but injury to vegetation will be avoided.

R. C. ROARK

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[8] Comey and Hahn, "Dictionary of Chemical Solubilities, Inorganic," 2nd ed., 1921.

THE TULSA MEETING OF THE AMERICAN CHEMICAL SOCIETY

THE seventy-first general meeting of the American Chemical Society was held at Tulsa, Oklahoma, from Monday, April 5, to Friday, April 9, inclusive. The council meeting was held on the 5th; a general business meeting on the morning of the 6th; special divisional meetings and symposiums on the afternoon of the 7th, and regular divisional meetings all day Wednesday and Thursday morning.

At the business meeting on the morning of April 6 the following were unanimously elected honorary members of the American Chemical Society: Bohuslav Brauner, Guiseppe Bruni, Ernst Cohen, Frederick G. Donnan, James C. Irvine, W. Lash Miller, Charles Moureu, Ame Pictet, Ira Remsen, Theodore W. Richards, Paul Sabatier, Joji Sakurai, Edgar Fahs Smith, Frederic Swarts. The certificates of honorary membership will be presented in person to most of these gentlemen at a special ceremony at the semi-centennial of the American Chemical Society.

Upon recommendation of the council, the general meeting voted that the name of Emil Fischer be restored to the list of deceased honorary members of the American Chemical Society.

It was also announced at the general meeting that the second award of the Priestley Medal for distinguished service to chemistry had been made by the Priestley Medal Committee to Edgar F. Smith. The medal will be presented at the Philadelphia meeting.

The registration showed 431 members and guests present. The society was welcomed by Cyrus S. Avery, chairman of the Oklahoma Highway Commission, and was followed by a response by President Norris. Professor B. S. Hopkins presented to the general meeting his announcement with details of the discovery of Element No. 61. Messrs. J. Allen Harris and L. S. Yntema were associated with Professor Hopkins in this discovery.

On Monday evening following the council meeting a reception and a dance were held at the Mayo Hotel.

On Tuesday evening A. D. Little, of Boston, presented a public address on "The Romance of Carbon" before an audience of some 700 people.

On Wednesday evening a special entertainment and smoker was enjoyed by all.

On Tuesday afternoon there was a general symposium by the division of petroleum chemistry on "Lubrication," of which R. R. Matthews was chairman, and also one by the division of chemical education on "Orientation and Segregation as applied in Chemical Education," of which W. Segerblom was chairman. The division of agricultural and food chemistry joint with the divisions of biological, cellulose and industrial and engineering chemistry held a symposium on Wednesday morning and afternoon on "Cotton and Its Products and Vegetable Oils," with David Wesson as chairman. The division of water, sewage and sanitation held an unusually large meeting and had a special excursion on Wednesday to the plants supplying water for Tulsa. The division of physical and inorganic chemistry, division of organic chemistry, division of gas and fuel chemistry and the section of history of chemistry held successful meetings.

Thursday afternoon and Friday were given up to excursions to refineries and to lead and zinc plants in Oklahoma. The meeting was naturally of especial interest to petroleum chemists, and by far the majority of those present were especially interested in the chemistry of this important raw material.

CHARLES L. PARSONS,
Secretary